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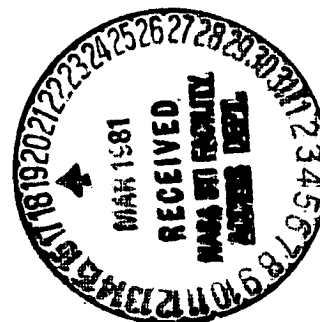
HOLIDAY OFFICE CENTER · 3322 MEMORIAL PKWY., S.W., SUITE 32 · HUNTSVILLE, ALABAMA 35801 · (205) 881-3472

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**COAL GASIFICATION SYSTEMS  
ENGINEERING AND ANALYSIS  
FINAL REPORT  
APPENDIX H - WORK BREAKDOWN STRUCTURE**

**December 31, 1980**

**BDM/H-80-800-TR**

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# THE BDM CORPORATION

## TABLE OF CONTENTS

<u>Chapter</u>		<u>Page</u>
	TABLE OF CONTENTS	H-iii
	LIST OF FIGURES	H-v
	LIST OF TABLES	H-vii
I	SUMMARY	H-I-1 to H-I-11
	A. Introduction	H-I-1
	B. Dimensions of the WBS	H-I-2
	C. WBS Matrix Summary	H-I-7
	D. WBS Document Organization	H-I-7
II	THE WBS MATRICES	H-II-1 to H-II-18
	A. WBS Dimensions	H-II-1
	B. WBS Numbering System	H-II-1
	C. Coal Gasification Program WBS Matrices	H-II-3
III	THE WBS DICTIONARY	H-III-1 to H-III-108
	A. Phases and Functions Dimension and Dictionary	H-III-1
	B. Hardware Elements Dimension and Dictionary	H-III-73

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LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
I-1	The Coal Gasification Program Hierarchy	H-I-3
I-2	Coal Gasification Program WBS - Phases and Functions Dimension	H-I-4
I-3	Coal Gasification Program WBS - Hardware Elements Dimension	H-I-6
I-4	WBS Matrix - Phases vs Plant and Modules	H-I-8
I-5	WBS Matrix - Plant and Modules vs Functions	H-I-9
I-6	WBS Matrix - Phases vs Functions	H-I-10
II-1	Coal Gasification Program Work Breakdown Structure Matrix - Program and Plant Summaries	H-II-5
II-2	Coal Gasification Program Work Breakdown Structure Matrix - Phase I and Module Summaries	H-II-7
II-3	Coal Gasification Program Work Breakdown Structure Matrix - Phase II and Module Summaries	H-II-9
II-4	Coal Gasification Program Work Breakdown Structure Matrix - Phase III and Module Summaries	H-II-11
II-5	Coal Gasification Program Work Breakdown Structure Matrix - Phase IV and Module Summaries	H-II-13
II-6	Coal Gasification Program Work Breakdown Structure Matrix - Phase III, Plant Implementation Function and Modules I & II	H-II-15
II-7	Coal Gasification Program Work Breakdown Structure Matrix - Phase III, Plant Implementation Function and Modules III & IV & Balance of Plant Systems	H-II-17
III-1	Coal Gasification Program WBS - Detailed Phases and Functions Dimension	H-III-3/4
III-2	Coal Gasification Program WBS - Detailed Hardware Elements Dimension	H-III-75/76

THE BDM CORPORATION

LIST OF TABLES

Table

Page

II-1

The WBS Numbering System

H-II-2

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CHAPTER I  
SUMMARY

A. INTRODUCTION

The Coal Gasification Program, because of its magnitude, duration, dollar costs, and rapid development of coal gasification technologies is a very complex program. A Work Breakdown Structure (WBS) that encompasses the multiple facets of this effort and accommodates the A/E cost estimating methodology as defined by Guthrie is developed herein. At the same time it is important that the WBS retain, as nearly as possible, the standard WBS format which is useful to program management. The WBS format enclosed will be used as a baseline and revised as necessary to accommodate the cost methodology.

Generally the work breakdown structure is a product oriented family tree composed of all the hardware, software, services, and other tasks necessary to define the program. It offers visual display, relates project elements, and defines the work to be accomplished. The WBS is then a tool for facilitating communications and understanding of a complex program by dividing this program into less complex, more manageable subdivisions or elements.

The greatest shortcoming of a single WBS is its inability to be all things for all people. The WBS provides a uniform basis for management and control, cost estimating, budgeting and reporting, scheduling activities, organizational structuring, specification tree generation, weight allocation and control, procurement and contracting activities, and serves as a tool for program evaluation. To do all these things and at the same time meaningfully relate elements of the program in an optical display and define the total work to be accomplished places demands upon the WBS that usually necessitate compromises.

Therefore, the WBS developed and defined herein is primarily tailored to the unique cost, economic, and programmatic requirements of the Coal Gasification Program. This WBS is designed to allow a standard and logical

## THE BDM CORPORATION

format for estimating the Coal Gasification Program cost, while at the same time permitting cost and economic comparisons of Coal Gasification Plant Systems to alternate and competitive candidate systems for each segment of the process plant.

### B. DIMENSIONS OF THE WBS

The Coal Gasification Program WBS has been conceived as the inter-relationship of three dimensions:

- (1) The phases and functions dimension
- (2) The hardware elements dimension
- (3) The elements of cost dimension.

The capability of the WBS is ultimately determined by the number of organizations with different perspectives that use it to analyze the Coal Gasification Program. Those organizations responsible for the design, engineering, construction, and testing of the plant may find the hardware elements dimension most useful. Those organizations responsible for the overall management of the program may find the phases and functions dimension most useful. Those organizations responsible for the financial accounting and control may find all three dimensions necessary.

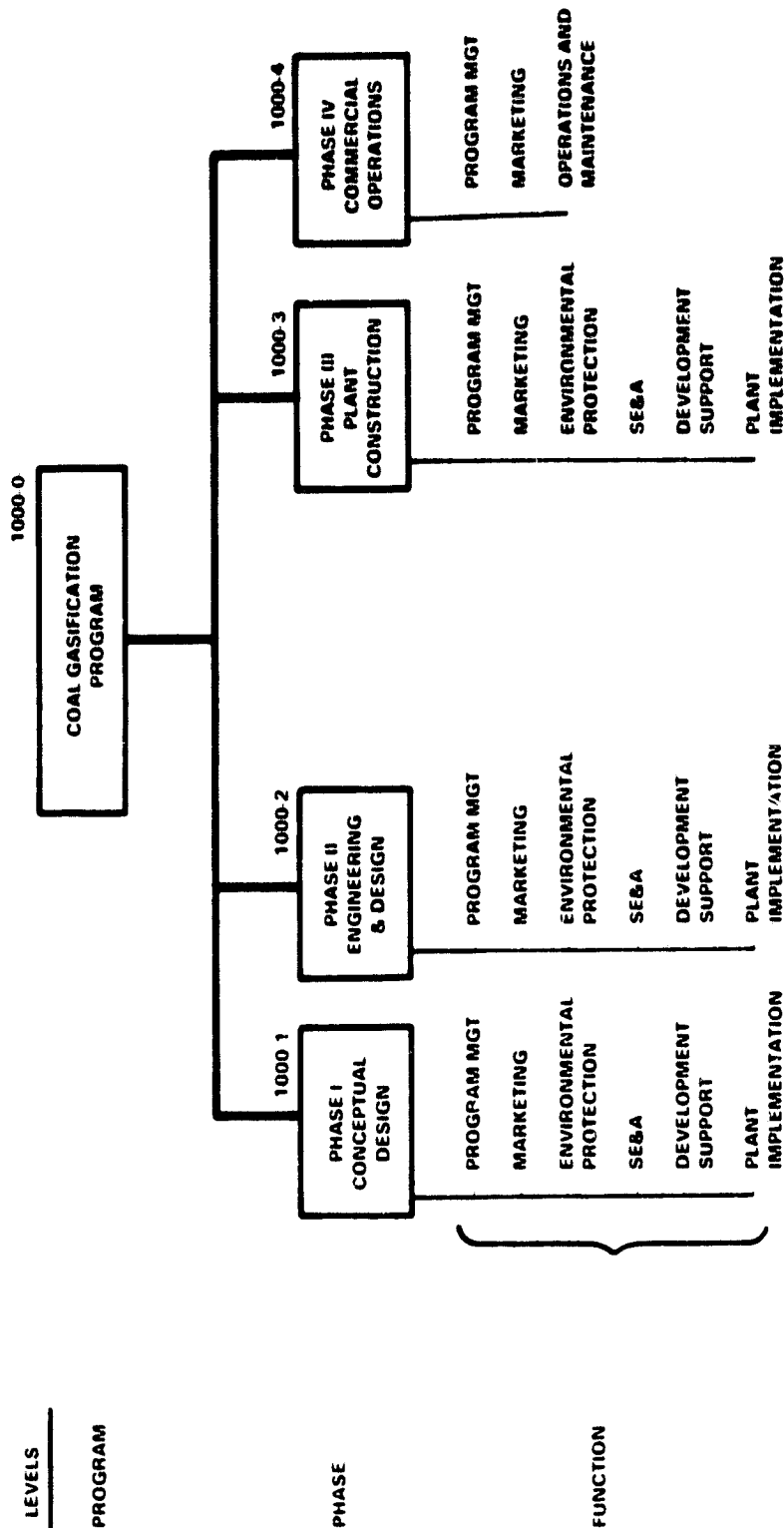
#### 1. Program Phases and Functions

The hierarchy of the Coal Gasification Program along the phases and functions dimension is shown in Figure I-1. The program has been divided into four major phases explained below. The functions required to satisfy the objectives of each phase are also illustrated. Figure I-2 illustrates the components of the phases and functions dimension to the subfunction level. It should be noted that not all functions or subfunctions are required for each phase of the program.

##### a. Phase I - Conceptual Designs

This phase encompasses the tasks associated with the conceptual design and siting of the coal gasification plant. The tasks include development of a conceptual design of the plant for five candidate processes; marketing surveys; siting studies; environmental assessments; systems engineering and analysis of the plant; and identification of needed technology development.





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Figure I-1. The Coal Gasification Program Hierarchy

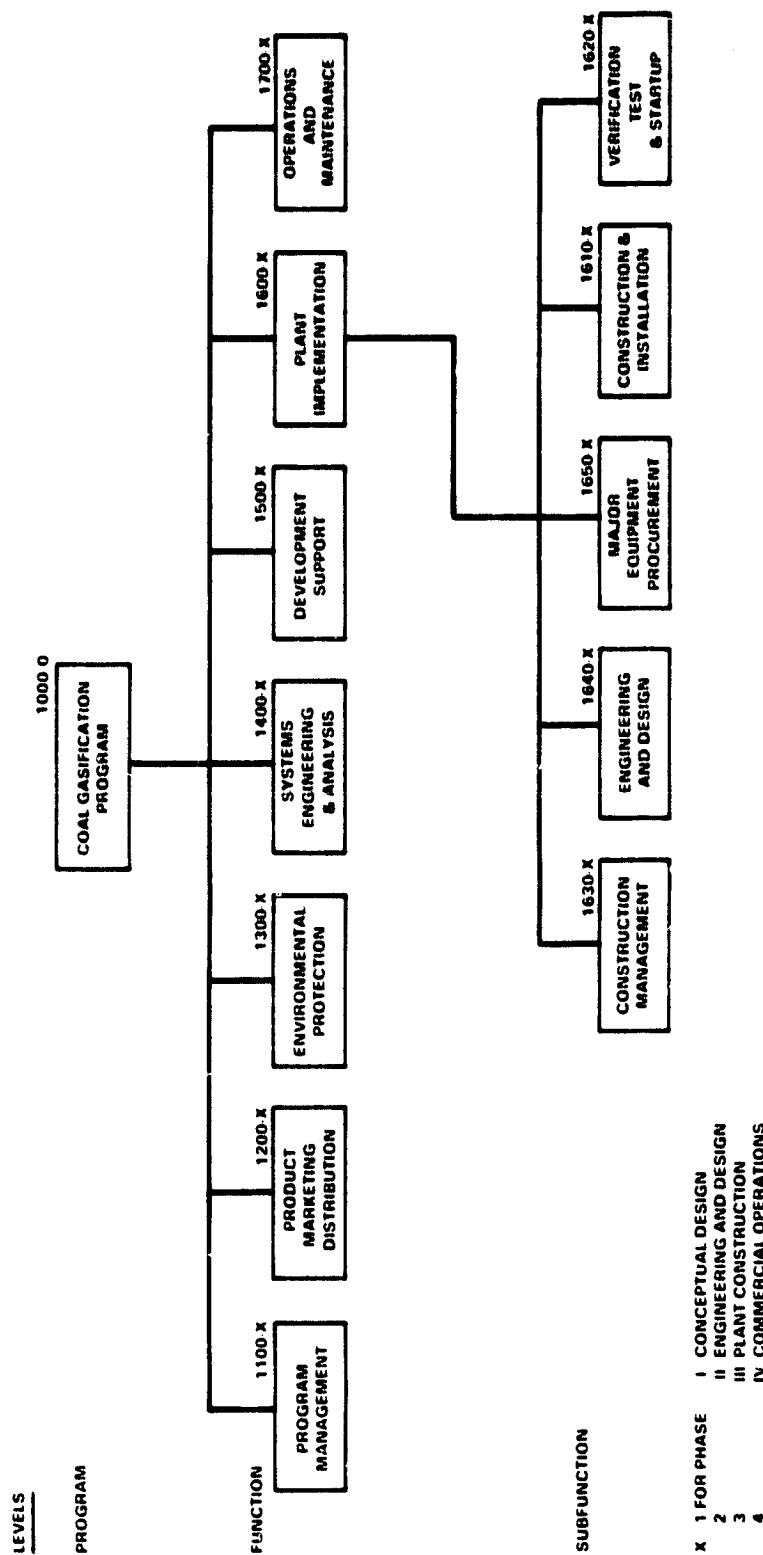


Figure I-2. Coal Gasification Program WBS - Phases and Functions Dimension

# THE BDM CORPORATION

## b. Phase II - Engineering and Design

This phase encompasses the tasks associated with the detailed design of the coal gasification plant for the selected processes. The tasks include development of the detailed design down to the subsystem level; design of supporting facilities; product pricing studies; environmental permits initiation; continued system engineering and analysis; and parallel conduct of technology development.

## c. Phase III - Plant Construction

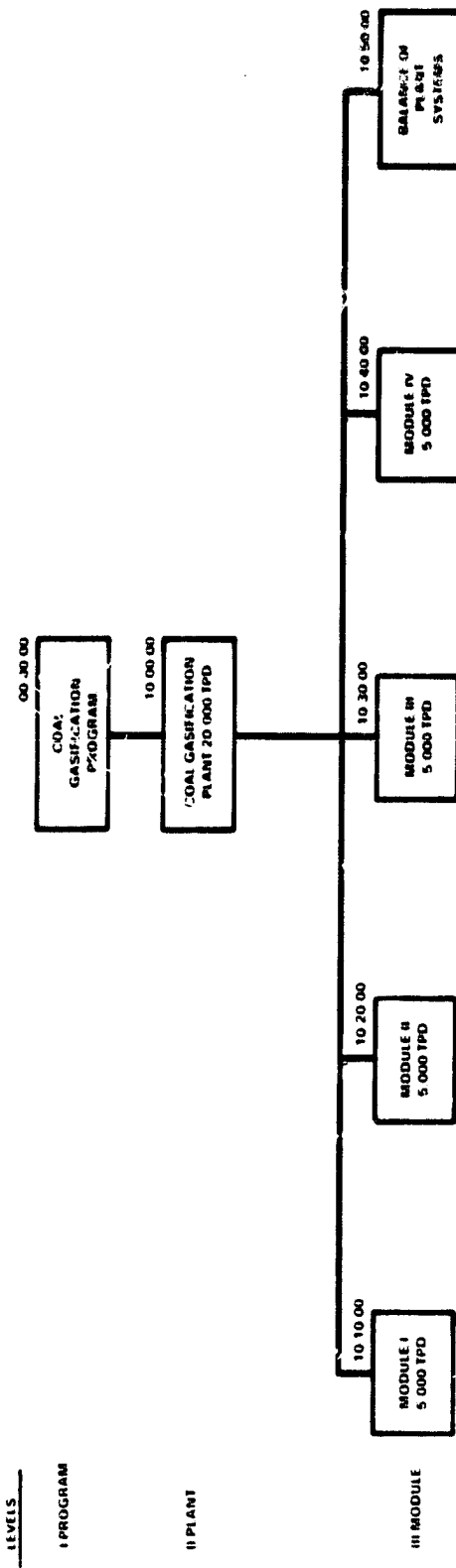
This phase encompasses the tasks associated with the final design, construction, startup and test of each 5000 TPD module of the plant. The tasks include detailed design of module components, system engineering and analysis, integration of the module into the design of the total facility, design of support facilities, construction, development of utility area interfaces, development and implementation of transportation operations, system and module tests, startup of the plant, and supporting technology development.

## d. Phase IV - Commercial Operations

This phase encompasses the tasks associated with operation of the plant. The tasks include continued technology support to assure full operating capability, engineering upgrade, procurement of raw materials, operation of the processes in the plant, disposal and shipping of plant output, procurement and stocking of spares, and conduct of preventive and corrective maintenance.

## 2. Hardware Elements

The hardware elements dimension contains all of the presently defined hardware elements of the Coal Gasification Plant broken out into plant, module, and system levels. Inherent in this dimension is the capability for further expansion to lower levels such as subsystem, assemblies, subassemblies, components, etc., limited only by the realism of the requirements. The hardware elements dimension of the Coal Gasification Program is shown in Figure I-3 to the module level. A hardware elements dimension broken out to the detailed system level is shown in Figure III-2.



H-I-6

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Figure I-3. Coal Gasification Program WBS - Hardware Elements Dimension

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### C. WBS MATRIX SUMMARY

The Coal Gasification Program WBS matrices may be summarized at the highest level as illustrated in Figures I-4 to I-6. The detailed WBS matrices are the subject of Chapter II and are illustrated in Figures II-1 to II-7.

- (1) A graphic display of each program phase versus the plant and modules is shown in Figure I-4. This display may be used to sum costs for each module to obtain a single cost for the Coal Gasification Plant by phase along the hardware elements dimension or to sum costs for each phase to obtain a single cost for the Coal Gasification Program along the phases and functions dimension.
- (2) A graphic display of the plant and modules versus the program functions is shown in Figure I-5. This display may be used to sum costs for each module to obtain a single cost for the Coal Gasification Plant by major function along the hardware elements dimension or to sum costs for each function to obtain a total module cost along the phases and functions dimension.
- (3) A graphic display of program phase versus the program functions is shown in Figure I-6. This display may be used to sum costs for each function to obtain a total phase cost or to sum costs by function to obtain a total function cost. Note that this graphic display essentially divides the phase and functions dimension into separate dimensions.

### D. WBS DOCUMENT ORGANIZATION

The remainder of the WBS document is divided into two chapters. Chapter II provides the overall WBS structure and the explanation of the numbering system derived for this WBS. Chapter III provides the details of

PHASES					
PLANT AND MODULES	PHASE I CONCEPTUAL DESIGN	PHASE II ENGINEERING & DESIGN	PHASE III PLANT CONSTRUCTION	PHASE IV COMMERCIAL OPERATION	PLANT & MODULE TOTALS
COAL GASIFICATION PLANT					
PLANT INTEGRATED SYSTEMS					
MODULE I					
MODULE II					
MODULE III					
MODULE IV					
BALANCE OF PLANT					
PROGRAM AND PHASE TOTALS					

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Figure I-4. WBS Matrix - Phases vs Plant and Modules

FUNCTIONS	PLANT AND MODULES							FUNCTION TOTALS
	COAL GASIFICATION PLANT	PLANT INTEGRATED SYSTEMS	MODULE I	MODULE II	MODULE III	MODULE IV	BALANCE OF PLANT	
PROGRAM MANAGEMENT								
PRODUCT MARKETING / DISTRIBUTION								
ENVIRONMENTAL PROTECTION								
SYSTEMS ENGINEERING & ANALYSIS								
DEVELOPMENT SUPPORT								
PLANT IMPLEMENTATION								
OPERATIONS AND MAINTENANCE								
PLANT AND MODULE TOTALS								

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Figure I-5. WBS Matrix - Plant and Modules vs Functions

FUNCTIONS	PHASES				
	PHASE I CONCEPTUAL DESIGN	PHASE II ENGINEERING & DESIGN	PHASE III PLANT CONSTRUCTION	PHASE IV COMMERCIAL OPERATION	FUNCTION TOTALS
PROGRAM MANAGEMENT					
PRODUCT MARKETING / DISTRIBUTION					
ENVIRONMENTAL PROTECTION					
SYSTEMS ENGINEERING & ANALYSIS					
DEVELOPMENT SUPPORT					
PLANT IMPLEMENTATION					
OPERATIONS AND MAINTENANCE					
PHASE TOTALS					

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Figure I-6. WBS Matrix - Phases vs Functions



## THE BDM CORPORATION

the WBS and the dictionary definition of each WBS element. The dictionary is divided into two parts:

- (1) The phases and functions dictionary which provides definitions of the program, phases, functions, subfunctions, and activities;
- (2) The hardware elements dimension which provides definitions of the plant, modules, and systems.

CHAPTER II  
THE WBS MATRICES

A. WBS DIMENSIONS

The Coal Gasification Program WBS matrix shown in Figures II-1 to II-7 is a three-dimensional structure that shows the interrelationship of

- (1) The hardware elements dimension
- (2) The phases and functions dimension
- (3) The elements of cost dimension.

This latter dimension is not further developed at this time but is provided to show the overall expansion capability built into the WBS matrix. This dimension will become more important in later years when the Coal Gasification Program approaches a Phase III start and is defined to the extent that the elements of cost can be planned and estimated with realism.

There is, of course, the fourth dimension of time which cannot be graphically shown but must be considered also. Each entry on the other three dimensions varies with time, and it is necessary to know these cost values by year for budget planning and approval, and to establish cost streams for discounting purposes.

While a multiple-dimensional approach may at first appear unduly complex, it actually provides benefits that far outweigh any such concern. This structural interrelationship provides the capability to view and analyze the Coal Gasification Program from a number of different financial and management aspects. Costs may be summed by hardware groupings, phases, functions, etc. The WBS may be used in a number of three-dimensional, two-dimensional, or single-listing format applications.

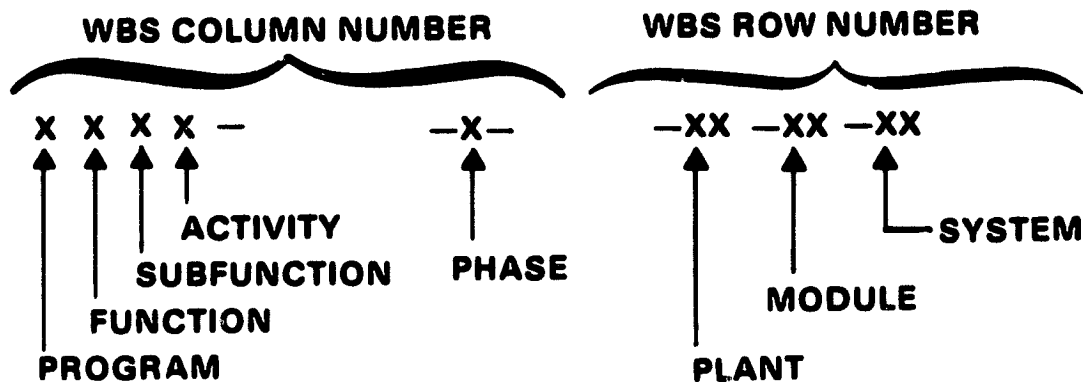
B. WBS NUMBERING SYSTEM

A systematic numerical coding system shown in Table II-1 coordinates the rows of the hardware elements dimension to the columns of the phases and functions dimension such that all matrix locations are identifiable by WBS numbers.

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TABLE II-1. THE WBS NUMBERING SYSTEM

## I. THE SCHEMA



## II. PROGRAM AND FUNCTION NUMBERS

COAL GASIFICATION PROGRAM	1000-X
PROGRAM MANAGEMENT	1100-X
PRODUCT MARKETING/DISTRIBUTION	1200-X
ENVIRONMENTAL PROTECTION	1300-X
SYSTEMS ENGINEERING AND ANALYSIS	1400-X
DEVELOPMENT SUPPORT	1500-X
PLANT IMPLEMENTATION	1600-X
OPERATIONS AND MAINTENANCE	1700-X

## III. PHASE NUMBERS

PHASE	I	CONCEPTUAL DESIGN	X=1
	II	ENGINEERING AND DESIGN	=2
	III	PLANT CONSTRUCTION	=3
	IV	COMMERCIAL OPERATIONS	=4

## IV. HARDWARE ELEMENTS NUMBERS

COAL GASIFICATION PLANT	10-00-00
MODULE I	10-10-00
MODULE II	10-20-00
MODULE III	10-30-00
MODULE IV	10-40-00
BALANCE OF PLANT SYSTEMS	10-50-00

## THE BDM CORPORATION

In the matrix figures which follow, a blank space signifies each matrix position that corresponds to an identifiable task that must be completed in the Coal Gasification Program. Therefore, each space also corresponds to a cost that will be incurred and must be accounted. Such a matrix display can also be used to record schedule dates and responsible organizations. Since each space corresponds to one particular column of the phases and functions dimension and one particular row of the hardware elements dimension, a complete definition of any matrix position is constructed by combining the definitions from the two applicable dimensions. That is, to avoid repetition, definitions are provided only once for each hardware elements dimension row and only once for each phases and functions dimension column, and a complete definition for any matrix position is a combination of these two definitions.

### C. COAL GASIFICATION PROGRAM WBS MATRICES

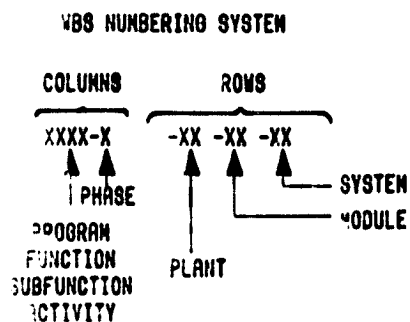
The Coal Gasification Program WBS matrices are divided into seven (7) displays

- (1) A graphic display of the three-dimensional WBS matrix (Figure II-1) for the entire Coal Gasification Program. This display allows one to sum costs for each module to obtain a single cost for the Coal Gasification Plant along the hardware elements dimension or to sum costs for each function to obtain subtotals for each phase and a single cost for the entire Coal Gasification Program along the phases and functions dimension.
- (2) Four (4) graphic displays of the three-dimensional WBS matrix (Figures II-2 to II-5) for each of the phases of the program. These displays allow one to sum costs for each module to obtain a single cost for the Coal Gasification Plant along the hardware elements dimension or to sum costs for each subfunction to obtain subtotals for each function and a single cost for each phase along the phases and functions dimension.
- (3) Two (2) graphic displays of the three dimensional WBS matrix (Figures II-6 and II-7) for the Plant Implementation Function of

## THE BDM CORPORATION

Phase III. These displays allow one to sum costs for each system to obtain subtotals for each module and a single cost for the Coal Gasification Plant along the hardware elements dimension or to sum costs for each activity to obtain subtotals for each sub-function and a single cost for the Plant Implementation Function of Phase III. These graphic displays have been charted on two graphs due to the depth and detail of the hardware elements dimension. Figure II-6 contains the Plant and Modules I and II. Figure II-7 contains the Modules III and IV as well as the Balance of Plant Systems.

# THE BDM CORPORATION



PROGRAM FUNCTION ACTIVITY		SYSTEM MODULE		PHASES & FUNCTIONS DIMENSION															PROGRAM				
PHASE		PLANT		FUNCTION															PHASE I 1 CONCEPTUAL				
				PROGRAM TOTAL																			
				PHASE I SUBTOTAL																			
				PROGRAM MANAGEMENT																			
				PRODUCT MARKETING																			
				ENVIRONMENTAL PROTECTION																			
				SYSTEMS ENGINEERING / DISTRIBUTION																			
				DEVELOPMENT SUPPORT																			
				PLANT IMPLEMENTATION																			
				PHASE II SUBTOTAL																			
				PROGRAM MANAGEMENT																			
				PRODUCT MARKETING																			
				ENVIRONMENTAL PROTECTION																			

HARDWARE ELEMENTS DIMENSION		WBS COLUMN NUMBER										WBS COLUMN NUMBER				
WBS TITLE	WBS ROW NUMBER	1000 -0-	1000 -1-	1100 -1-	1200 -1-	1300 -1-	1400 -1-	1500 -1-	1600 -1-	1700 -1-	1800 -2-	1100 -2-	1200 -2-	1300 -2-	1400 -2-	
COAL GASIFICATION PLANT	-10-00-00															
PLANT INTEGRATED SYSTEMS	-11-00-00															
MODULE I	-10-10-00															
INTEGRATED SYSTEMS	-10-11-00															
MODULE II	-10-20-00															
INTEGRATED SYSTEMS	-10-21-00															
MODULE III	-10-30-00															
INTEGRATED SYSTEMS	-10-31-00															
MODULE IV	-10-40-00															
INTEGRATED SYSTEMS	-10-41-00															
BALANCE OF PLANT SYSTEMS	-10-50-00															
INTEGRATED SYSTEMS	-10-51-00															



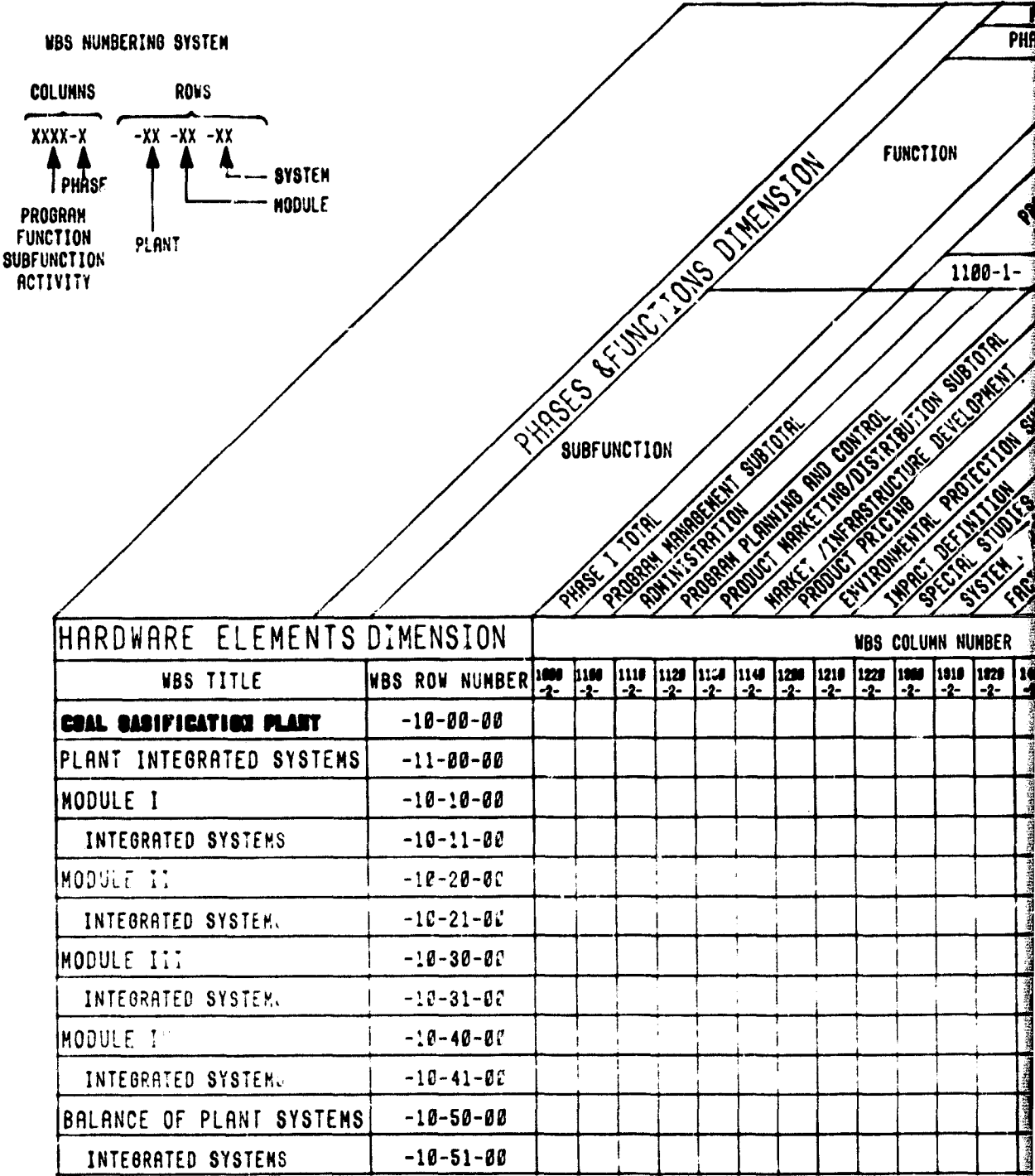


FIGURE II-2. COAL GASIFICATION PROJECT STRUCTURE MATRIX -- PHASE I





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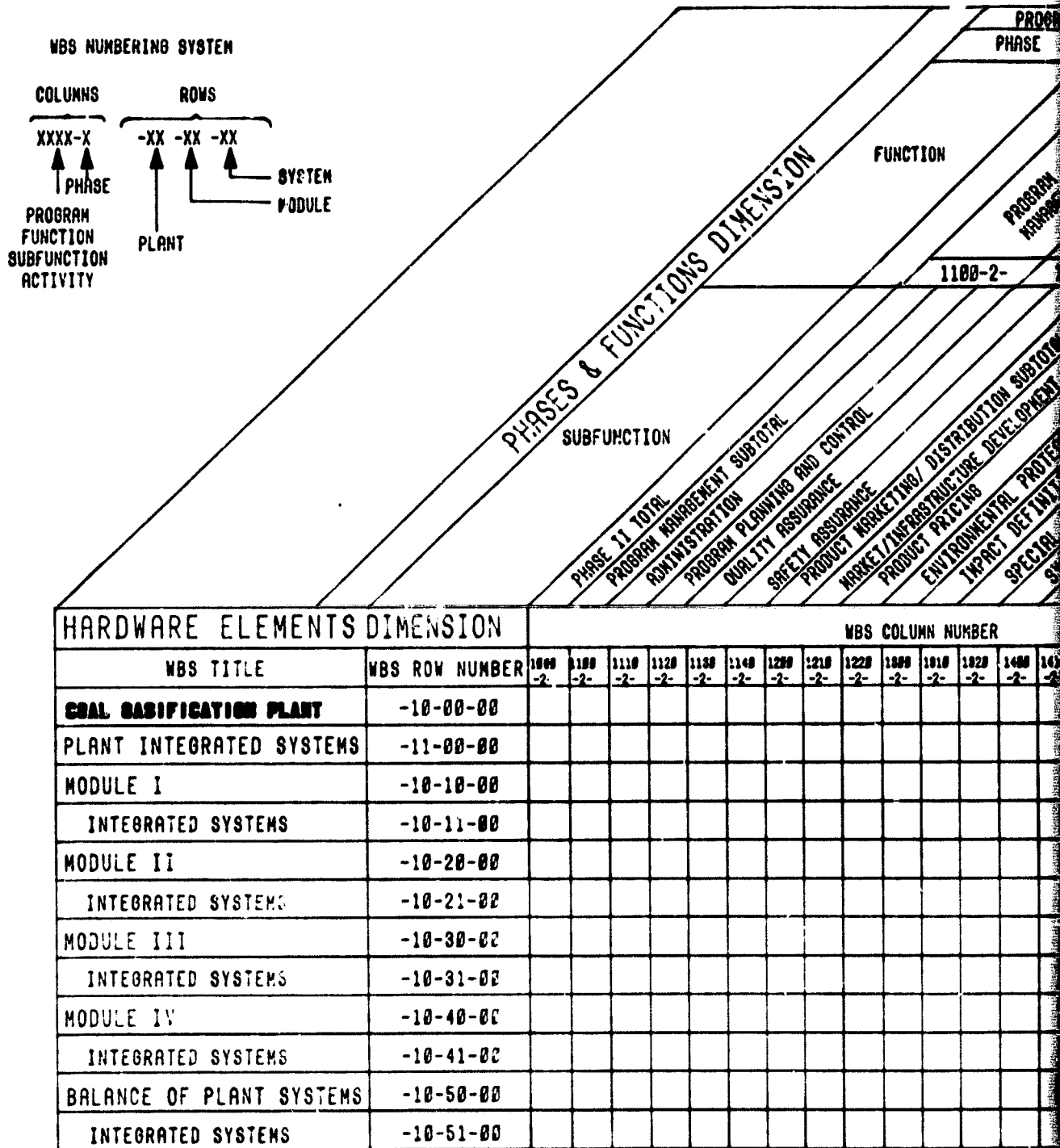
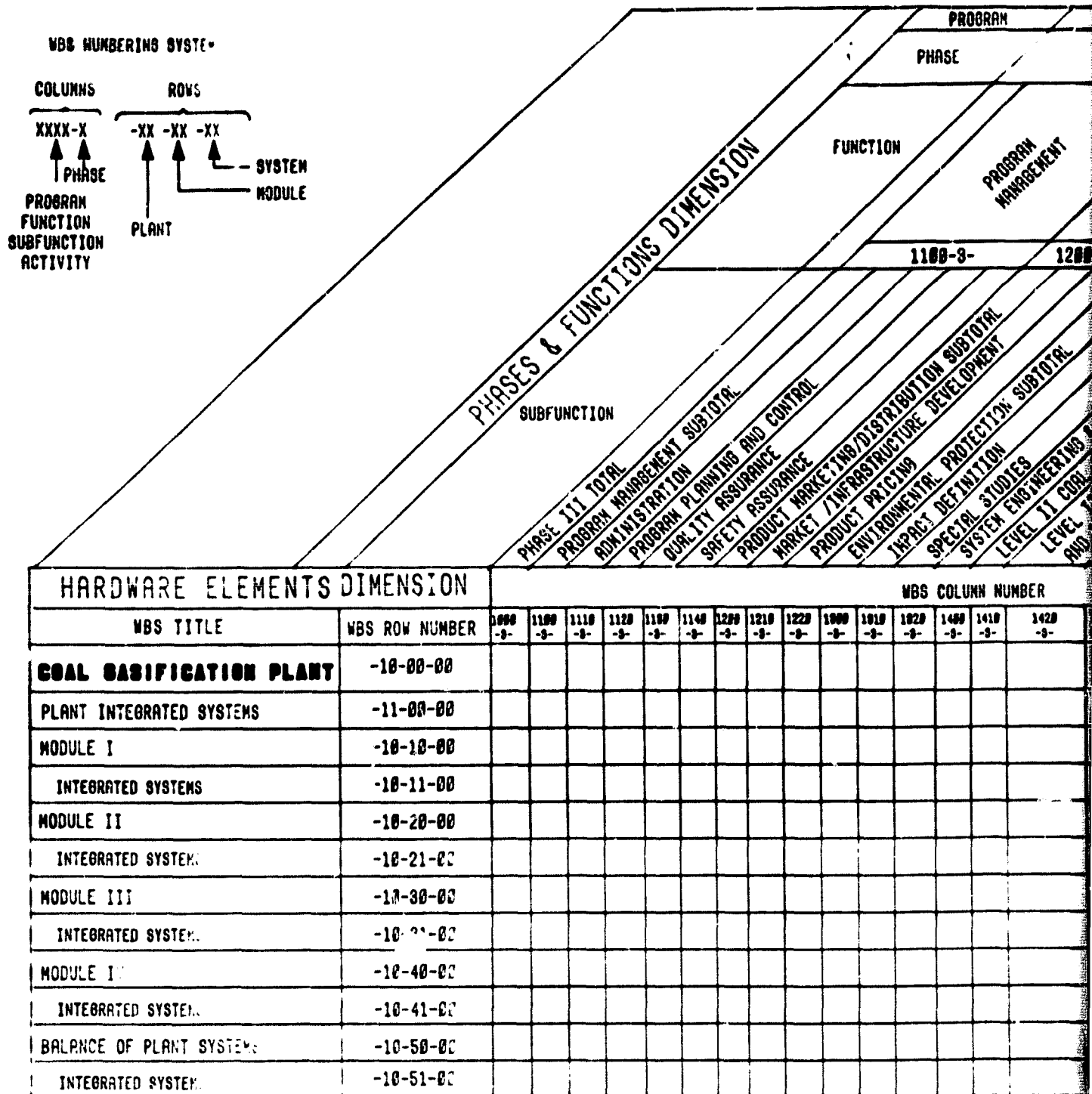


FIGURE II-3. COAL GASIFICATION PROGRAM  
STRUCTURE MATRIX -- PHASE II AND

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FIGURE II-4. COAL GASIFICATION PROJECT STRUCTURE MATRIX -- PHASE III AND

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PROGRAM													COAL GASIFICATION PROGRAM 1000-0												
PHASE													PHASE III 1000-3- PLANT CONSTRUCTION												
PROGRAM MANAGEMENT													PROGRAM MARKETING/DISTRIBUTION												
ENVIRONMENTAL PROTECTION													SYSTEMS ENGINEERING & ANALYSIS												
DEVELOPMENT SUPPORT													PLANT IMPLEMENTATION												
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# THE BDM CORPORATION

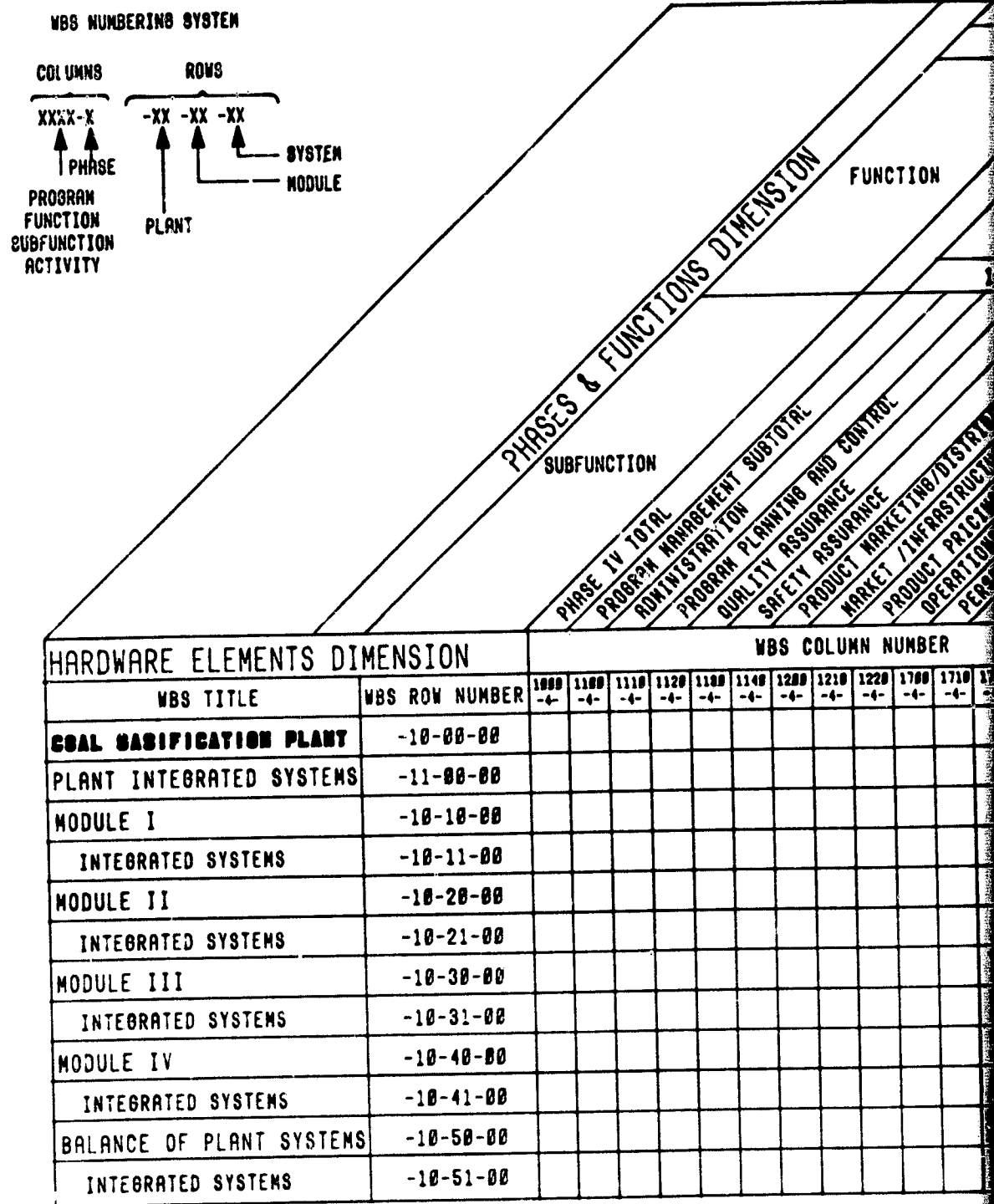


FIGURE II-5. COAL GASIFICATION PROJECT  
STRUCTURE MATRIX -- PHASE IV AND

FOLDOUT FRAMES

FUNCTION		COAL GASIFICATION PROGRAM 1000-0-																	
PHASE		PHASE IV 1000-4 COMMERCIAL OPERATIONS																	
1100-4-		1200-4-		1700-4-															
PROGRAM MANAGEMENT		PRODUCT MARKETING/ DISTRIBUTION		OPERATIONS AND MAINTENANCE															
TOTAL		SUBTOTAL		SUBTOTAL															
SAFETY ASSURANCE		MARKET /INFRASTRUCTURE DEVELOPMENT		PERSONNEL TRAINING															
PRODUCT MARKETING/DISTRIBUTION		OPERATIONS AND MAINTENANCE		SPARES PROCUREMENT															
MARKET /INFRASTRUCTURE DEVELOPMENT		PLANT OPERATIONS		MAINTENANCE AND REPAIR															
OPERATIONS AND MAINTENANCE		PLANT ENGINEERING		MATERIALS PROCESSING															
PERSONNEL TRAINING		LABOR DOLLARS		FRINGE BENEFITS															
SPARES PROCUREMENT		EQUIPMENT AND HARDWARE		MATERIALS															
MAINTENANCE AND REPAIR		SUBCONTRACTS		EQUIPMENT, HARDWARE, MATERIAL, AND SUBCONTRACT BURDEN															
PLANT OPERATIONS		OTHER DIRECT COSTS		OVERHEAD															
PLANT ENGINEERING		GENERAL AND ADMINISTRATIVE		OTHER INDIRECT COSTS															
MATERIALS PROCESSING																			
LABOR HOURS																			
PROGRAM MANAGEMENT																			
PRODUCT MARKETING/DISTRIBUTION																			
ENVIRONMENTAL PROTECTION																			
SYSTEMS ENGINEERING & ANALYSIS																			
DEVELOPMENT SUPPORT																			
PLANT IMPLEMENTATION																			
OPERATIONS AND MAINTENANCE																			

S COLUMN NUMBER									
1200	1210	1220	1700	1710	1720	1730	1740	1750	1760
-4-	-4-	-4-	-4-	-4-	-4-	-4-	-4-	-4-	-4-

FOLDOUT FRAME

GASIFICATION PROGRAM WORK BREAKDOWN  
X -- PHASE IV AND MODULE SUMMARIES

H-II-13/14

**THE BDM CORPORATION**

**Figures II-6 to II-7 of  
THE COAL GASIFICATION PROGRAM MATRICES  
ARE PROVIDED AS ENCLOSURES IN THE BACK COVER.**

**H-II-15 to H-II-18**



THE BDM CORPORATION

CHAPTER III

THE WBS DICTIONARY

A. PHASES AND FUNCTIONS DIMENSION AND DICTIONARY

CHAPTER III  
WBS DICTIONARY

A. PHASES AND FUNCTIONS DIMENSION AND DICTIONARY

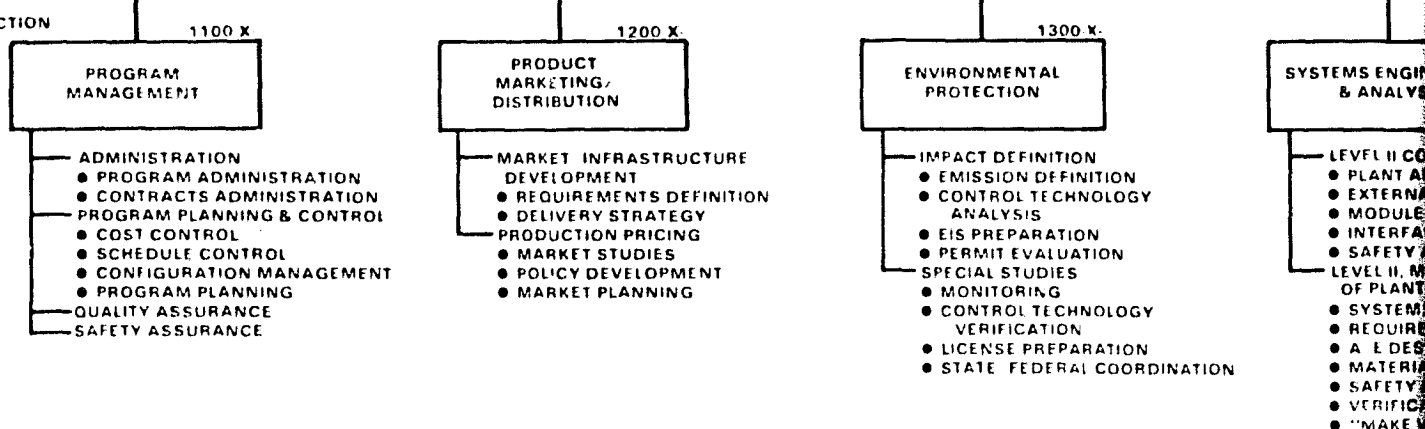
The phases and functions dimension is divided into four major phases. Each of these four phases is subsequently subdivided into functions such as program management, product marketing/distribution, environmental protection, systems engineering and analysis, development support, plant implementation and operations, and each can be further subdivided into subfunctions such as construction management, engineering and design, major equipment procurement, and installation and verification test of startup, etc. An illustration of a typical WBS for the phases and functions dimension is shown in Figure III-1. Definitions of the individual elements are contained in the following pages.

# THE BDM CORPORATION

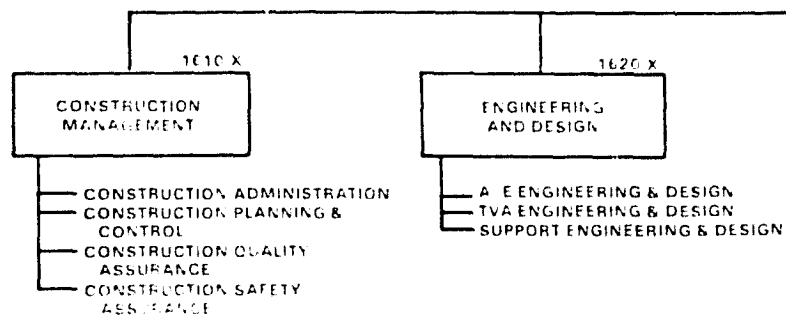
## LEVELS

### PROGRAM

### FUNCTION



### SUBFUNCTION • ACTIVITY



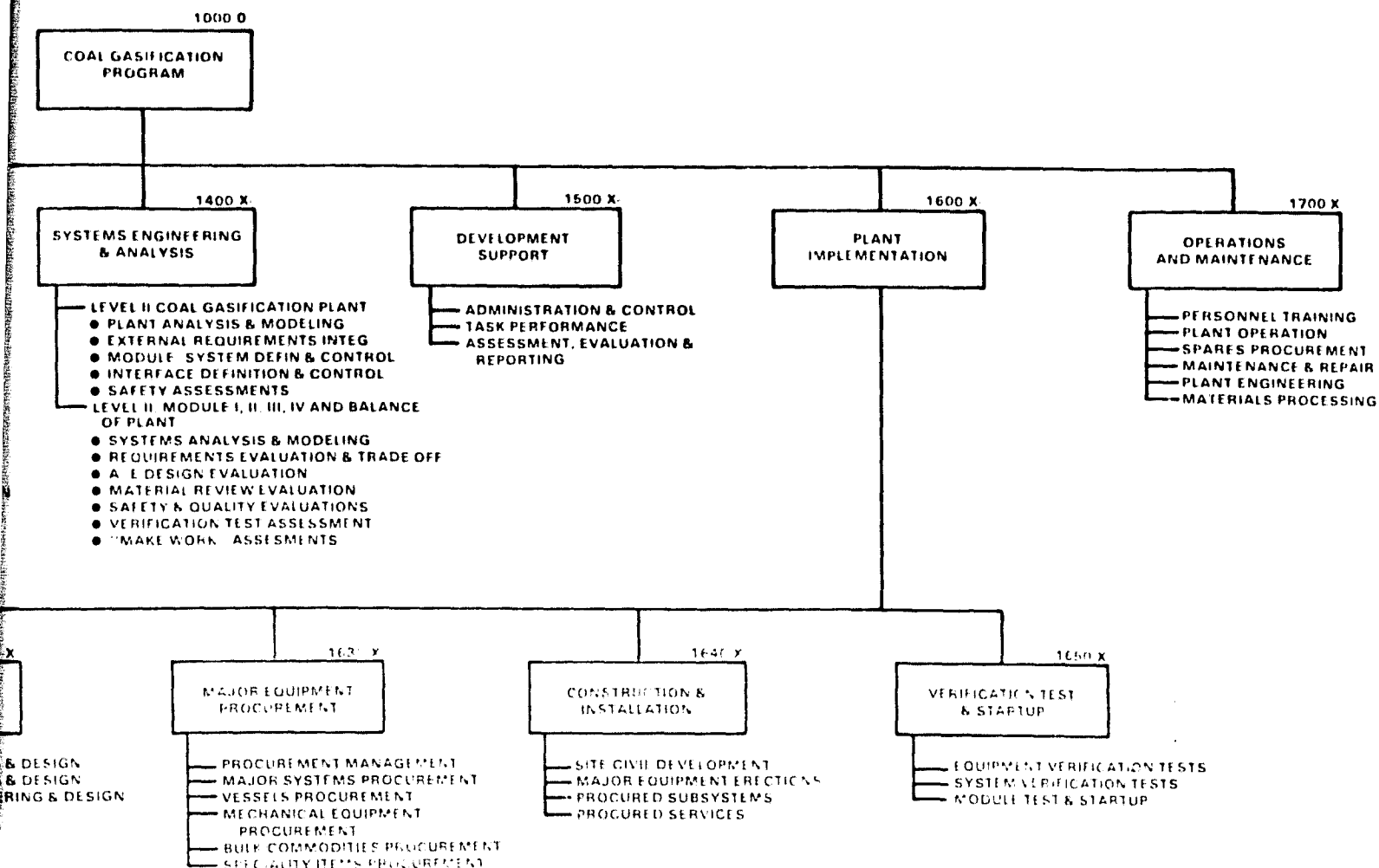
- 1. PLANT DESIGN
- 2. PLANT ENGINEERING AND DESIGN
- 3. PLANT CONSTRUCTION
- 4. PLANT COMMERCIAL OPERATIONS

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Figure 111-1. Coal Gasification Program



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# THE BDM CORPORATION

## PHASES AND FUNCTIONS DICTIONARY CONTENTS

### WBS NUMBER(S)

### WBS TITLE

#### PROGRAM AND PHASE LEVELS

1000-0-

Coal Gasification Program

1000-1-

Phase I - Conceptual Design

1000-2-

Phase II - Engineering and Design

1000-3-

Phase III - Plant Construction

1000-4-

Phase IV - Commercial Operations

#### FUNCTION LEVEL

1100-1-

Program Management

1100-2-

1100-3-

1100-4-

1200-1-

Product Marketing/Distribution

1200-2-

1200-3-

1200-4-

1300-1-

Environmental Protection

1300-2-

1300-3-

1400-1-

Systems Engineering and Analysis

1400-2-

1400-3-

1500-1-

Development Support

1500-2-

1500-3-

PHASES AND FUNCTIONS DICTIONARY  
CONTENTS (CONTINUED)

WBS NUMBER(S)

WBS TITLE

1600-1-

Plant Implementation

1600-2-

1600-3-

1700-4-

Operations and Maintenance

SUBFUNCTION LEVEL

1110-1-

Administration

1110-2-

1110-3-

1110-4-

1120-1-

Program Planning and Control

1120-2-

1120-3-

1120-4-

1130-2-

Quality Assurance

1130-3-

1130-4-

1140-2-

Safety Assurance

1140-3-

1140-4-

1210-1-

Market/Infrastructure Development

1210-2-

1210-3-

1210-4-

# THE BDM CORPORATION

## PHASES AND FUNCTIONS DICTIONARY CONTENTS (CONTINUED)

<u>WBS NUMBER(S)</u> <u>SUBFUNCTION LEVEL (CONTINUED)</u>	<u>WBS TITLE</u>
1220-1-	Product Pricing
1220-2-	
1220-3-	
1220-4-	
1310-1-	Impact Definition
1310-2-	
1310-3	
1320-1-	Special Studies
1320-2-	
1320-3-	
1410-1-	Facility Analysis
1420-1-	Facility Definition
1430-1-	Comparative Evaluation
1440-1-	Programmatic/Cost Analysis
1410-2-	Plant Analysis and Modeling
1420-2-	
1410-3-	Level II Coal Gasification Plant
1420-3-	
1510-3-	Administration and Control

# THE BDM CORPORATION

## PHASES AND FUNCTIONS DICTIONARY CONTENTS (CONTINUED)

<u>WBS NUMBER(S)</u> <u>SUBFUNCTION LEVEL (CONTINUED)</u>	<u>WBS TITLE</u>
1520-3-	Task Performance
1530-1-	Assessment, Evaluation and Reporting
1530-2-	
1530-3-	
1610-3-	Construction Management
1620-1-	Engineering and Design
1620-2-	
1620-3-	
1630-3-	Major Equipment Procurement
1640-3-	Construction and Installation
1650-3-	Verification Test and Startup
1710-4-	Personnel Training
1720-4-	Plant Operations
1730-4-	Spares Procurement
1740-4-	Maintenance and Repair
1750-4-	Plant Engineering
1760-4-	Materials Processing



PHASES AND FUNCTIONS DICTIONARY  
CONTENTS (CONTINUED)

<u>WBS NUMBER(S)</u> <u>ACTIVITY LEVEL</u>	<u>WBS TITLE</u>
1611-3-	Construction Administration
1612-3-	Construction Planning and Control
1613-3-	Construction Quality Assurance
1614-3-	Construction Safety Assurance
1621-3-	A/E Engineering and Design
1622-3-	TVA Engineering and Design
1623-3-	Support Engineering and Design
1631-3-	Procurement Management
1632-3-	Major Systems Procurement
1633-3-	Vessels Procurement
1634-3-	Mechanical Equipment Procurement
1635-3-	Bulk Commodities Procurement
1636-3-	Specialty Items Procurement
1641-3-	Site Civil Development
1642-3-	Major Equipment Erections
1643-3-	Procured Subsystems Installation
1644-3-	Procured Services
1651-3-	Equipment Verification Tests
1652-3-	System Verification Tests
1653-3-	Module Test and Startup

## THE BDM CORPORATION

WBS Number: 1000-0-  
WBS Phase: N/A  
WBS Title: Coal Gasification Program

This element sums all efforts and materials required for the design, development, construction, test and operations of the total program. This element is divided into the following lower elements:

1000-1-	Phase I	-	Conceptual Design
1000-2-	Phase II	-	Engineering and Design
1000-3-	Phase III	-	Plant Construction
1000-4-	Phase IV	-	Commercial Operations

# THE BDM CORPORATION

WBS Number: 1000-1-  
WBS Phase: I  
WBS Title: Phase I - Conceptual  
Design

This phase encompasses the tasks associated with the conceptual design and siting of the coal gasification plant. The tasks include development of a conceptual design of the plant for five candidate processes; siting studies; environmental assessments; systems engineering and analysis of the plant; and identification of needed technology development. This element is divided into the following functions:

- 1100-1- Program Management
- 1200-1- Product Marketing/Distribution
- 1300-1- Environmental Protection
- 1400-1- Systems Engineering and Analysis
- 1500-1- Development Support
- 1600-1- Plant Implementation

## THE BDM CORPORATION

WBS Number: 1000-2-  
WBS Phase: II  
WBS Title: Phase II - Engineering  
and Design

This phase encompasses the tasks associated with the detailed engineering and design of the coal gasification facility for the selected process. The tasks include development of the detailed design down to the subsystem level; design of supporting facilities; continued system engineering and analysis; and parallel conduct of technology development. This element is divided into the following functions:

- 1100-2- Program Management
- 1200-2- Product Marketing/Distribution
- 1300-2- Environmental Protection
- 1400-2- Systems Engineering and Analysis
- 1500-2- Development Support
- 1600-2- Plant Implementation

## THE BDM CORPORATION

WBS Number: 1000-3-  
WBS Phase: III  
WBS Title: Phase III - Plant  
Construction

This phase encompasses the tasks associated with the final engineering and design, construction, startup and test of all 5000 TPD modules of the plant. The tasks include construction management, detailed engineering and design of module components, major equipment procurement, integration of module into the design of the total plant, design of support facilities, plant construction and installation, system and module tests, and startup of the plant. This element is divided into the following functions:

- 1100-3- Program Management
- 1200-3- Products Marketing/Distribution
- 1300-3- Environmental Protection
- 1400-3- Systems Engineering and Analysis
- 1500-3- Development Support
- 1600-3- Plant Implementation

## THE BDM CORPORATION

WBS Number: 1000-4-  
WBS Phase: IV  
WBS Title: Phase IV - Commercial  
Operations

This phase encompasses the tasks associated with the commercial operation of the plant. The tasks include continued technology support to assure full operating capability, engineering upgrade, procurement of raw materials, operation of the processes in the plant, disposal and shipping of plant output, procurement and stocking of spares, and conduct of preventive and corrective maintenance. This element is subdivided into the following functions:

- 1100-4- Program Management
- 1200-4- Product Marketing/Distribution
- 1700-4- Operations and Maintenance

## THE BDM CORPORATION

WBS Numbers: 1100-1-  
1100-2-  
1100-3-  
1100-4-  
WBS Phases: I - IV  
WBS Title: Program Management

This element includes all efforts and material required to ensure fundamental direction, and making decisions to ensure that a fully functioning plant is designed, built, started, tested and operated on schedule and within budget. Specific lower level program elements which are included are:

1110-1- Administration  
1110-2-  
1110-3  
1110-4-

1120-1- Program Planning and Control  
1120-2-  
1120-3-  
1120-4-

1130-2- Quality Assurance  
1130-3-  
1130-4-

1140-2- Safety Assurance  
1140-3-  
1140-4-

These items sum all efforts required to provide direction and control of the development of the plant, including the efforts required for planning, organizing, directing, coordinating, and controlling the program to ensure that overall program objectives are accomplished. These efforts overlay the other functional categories and assure that they are properly integrated.

## THE BDM CORPORATION

WBS Numbers: 1200-1-

1200-2-

1200-3-

1200-4-

WBS Phases: I - IV

WBS Title: Product Marketing/  
Distribution

This element includes all studies directed at defining and quantifying the market for the product of the plant, the determination of product pricing strategies, and the development and refinement of marketing plans. Specific lower level program elements which are included are:

1210-1- Market/Infrastructure Development

1210-2-

1210-3-

1210-4-

1220-1- Product Pricing

1220-2-

1220-3-

1220-4-



# THE BDM CORPORATION

WBS Numbers: 1300-1-

1300-2-

1330-3-

WBS Phases: I - III

WBS Title: Environmental Protection

This element includes all studies and materials associated with the definition of environmental impact of the plant, preparation of environmental impact statements, and procedures required to safeguard the environment and to secure the operating license for the plant. Specific lower level program elements which are included are:

1310-1- Impact Definition

1310-2-

1310-3-

1320-1- Special Studies

1320-2-

1320-3-

## THE BDM CORPORATION

WBS Numbers: 1400-1-  
1400-2-  
1400-3-  
WBS Phases: I - III  
WBS Title: Systems Engineering and  
Analysis

This element of Phases I through III involves analysis to complement and support the design and development element. The tasks in Phase I include analysis of facility requirements; tradeoff studies on alternative processes; programmatic, cost and economic analysis; and comparative evaluation of A/E conceptual designs. The tasks in Phase II include detailed plant analysis and modeling, and accumulation of information regarding commercial operating experience. The tasks in Phase III are directed at support of the final engineering of the plant and its construction. Specific lower level program elements which are included are:

- 1410-1- Facility Analysis
- 1420-1- Facility Definition
- 1430-1- Comparative Evaluation
- 1440-1- Programmatic/Cost Analysis
  
- 1410-2- Plant Analysis and Modeling
- 1420-2- Commercial Operating Experience
  
- 1410-1- Level II Coal Gasification Plant
- 1420-3- Level III/Models I, II, III, IV and Balance of Plant

# THE BDM CORPORATION

WBS Numbers: 1500-1-

1500-2-

1500-3-

WBS Phases: I - III

WBS Title: Development Support

This element of Phases I - III involves application of current and advanced technology to support process and system selection, design, construction, test, evaluation, and improvement. The tasks will be defined as the program develops and will include efforts to assess and evaluate the Coal Gasification Program as well as plant implementation effort. Specific lower level program elements which are included are:

1510-3- Administration and Control

1520-3- Task Performance

1530-1- Assessment, Evaluation and Reporting

1530-2-

1530-3-

# THE BDM CORPORATION

WBS Numbers: 1600-1-  
1600-2-  
1600-3-  
WBS Phases: I - III  
WBS Title: Plant Implementation

This element involves the engineering and design, construction management, major equipment procurement, construction and installation, verification test and startup of each module of the coal gasification plant. Specific lower level program elements which are included are:

1610-3- Construction Management

1620-1- Engineering and Design

1620-2-

1620-3-

1630-3- Major Equipment Procurement

1640-3- Construction and Installation

1650-3- Verification Test and Startup

## THE BDM CORPORATION

WBS Number: 1700-4-  
WBS Phase: IV  
WBS Title: Operations and  
Maintenance

This element of Phase IV includes the effort and materials for the operations and maintenance of each module of the coal gasification plant.

This element is subdivided into the following subfunctions:

- 1710-4- Personnel Training
- 1720-4- Plant Operations
- 1730-4- Spares Procurement
- 1740-4- Maintenance and Repair
- 1750-4- Plant Engineering
- 1760-4- Materials Processing

## THE BDM CORPORATION

WBS Numbers: 1110-1-

1110-2-

1110-3-

1110-4-

WBS Phases: I - IV

WBS Title: Administration

This element sums all efforts and materials required for the administration of the Coal Gasification Program. This subfunction includes the activities of program administration and contract administration.

## THE BDM CORPORATION

WBS Numbers: 1120-1-  
1120-2-  
1120-3-  
1120-4-  
WBS Phases: I - IV  
WBS Title: Program Planning and  
Control

This element sums all efforts and materials required for Program Planning and Control. This subfunction includes the activities of cost control, schedule control, and configuration management and program planning within the Coal Gasification Program.

## THE BDM CORPORATION

WBS Numbers: 1130-2-  
1130-3-  
1130-4-  
WBS Phases: II - IV  
WBS Title: Quality Assurance

This element sums all efforts and materials required to assure reliability and maintainability of the Coal Gasification Program. This subfunction includes reliability, maintainability and quality studies in Phase II, as well as the nonconstruction related quality issues of Phase III. The work element Construction Quality Assurance (1613-3-) is a separate effort during Phase III. This element also provides for quality assurance of product during the plant commercial operations in Phase IV.



## THE BDM CORPORATION

WBS Numbers: 1140-2-  
1140-3-  
1140-4-  
WBS Phases: II - IV  
WBS Title: Safety Assurance

This element sums all efforts and materials required to assure safety within the Coal Gasification Program. This subfunction includes safety studies in Phase II, as well as the nonconstruction related safety issues of Phase III. The work element Construction Safety Assurance (1614-3-) is a separate effort during Phase III. This subfunction also provides for operational safety during the plant commercial operations in Phase IV.

## THE BDM CORPORATION

WBS Numbers: 1210-1-

1210-2-

1210-3-

1210-4-

WBS Phases: I - IV

WBS Title: Market/Infrastructure  
Development

This element sums all efforts and materials to perform Market/Infrastructure Development. This subfunction includes market requirements definition during Phases I and II and the development of delivery strategies during Phases III and IV.

## THE BDM CORPORATION

WBS Numbers: 1220-1-

1220-2-

1220-3-

1220-4-

WBS Phases: I - IV

WBS Title: Product Pricing

This element sums all efforts and materials to perform Product Pricing. This subfunction includes market studies, policy development, market planning and continual efforts to define pricing strategy throughout all phases.

## THE BDM CORPORATION

WBS Numbers: 1310-1-  
1310-2-  
1310-3-  
WBS Phases: I - III  
WBS Title: Impact Definition

This element sums all efforts and materials to perform Impact Definition for environmental protection concerns. This subfunction includes emission definition, control technology analysis, environmental impact statement preparation and permit evaluation. All evaluations which are made to define the environmental impact of the plant during construction and operation are included in this subfunction.

## THE BDM CORPORATION

WBS Numbers: 1320-1-  
1320-2-  
1320-3-  
WBS Phases: I - III  
WBS Title: Special Studies

This element sums all efforts and materials required to perform Special Studies related to the actual environmental monitoring of the plant during operation. This subfunction includes, plant monitoring efforts, control technology verification and selection, operating license preparation and coordination of state and federal environmental concerns.

## THE BDM CORPORATION

WBS Number: 1410-1-  
WBS Phase: I  
WBS Title: Facility Analysis

This element sums all efforts and materials required to perform a Facility Analysis of the Coal Gasification Plant. This subfunction includes the identification of candidate systems/subsystems and the parameters necessary to conduct facility/module tradeoffs, a raw materials analysis, a market analysis of by-products, an assessment of alternate products options and an identification of preliminary facility requirements.

## THE BDM CORPORATION

WBS Number: 1420-1-  
WBS Phase: I  
WBS Title: Facility Definition

This element sums all efforts and materials required to perform a Facility Definition of the Coal Gasification Plant. This subfunction includes a determination of mass/energy balances for candidate facilities, identification of selected systems and a detailed analysis of these systems, a determination of coal variation tradeoffs, an evaluation of the use of steam versus electric drives throughout the facility and the definition of reference facilities for comparative evaluation.

## THE BDM CORPORATION

WBS Number: 1430-1-

WBS Phase: I

WBS Title: Comparative Evaluation

This element sums all efforts and materials required to perform a Comparative Evaluation of A/E Conceptual Designs. This subfunction includes the development of a comparative evaluation criteria, the comparative evaluation of A/E submitted designs and the development of a synthesized recommended design.



## THE BDM CORPORATION

WBS Number: 1440-1-  
WBS Phase: I  
WBS Title: Programmatic/Cost  
Analysis

This element sums all efforts and materials required to perform a Programmatic and Cost Analysis of the Coal Gasification Plant. This sub-function includes the development of reference facility schedules and logic networks, the development of a work breakdown structure to be used by the Coal Gasification Program for management and control, the derivation of a cost estimation and economic evaluation methodology, the evaluation of life cycle costs for the candidate facilities, the performance of cost sensitivities and cash flow analysis, and the comparative evaluation of the price competitiveness of the gasification project fuels with nonsynthetic fuels.

## THE BDM CORPORATION

WBS Number: 1410-2-  
WBS Phase: II  
WBS Title: Plant Analysis and  
Modeling

This element sums all efforts and materials required to perform a detailed Plant Analysis and Modeling. This subfunction includes the development of a dynamic model for the coal gasification plant and the collection of data related to system performance.

**THE BDM CORPORATION**

WBS Number: 1420-2-  
WBS Phase: II  
WBS Title: Commercial Operating  
Experience

This element sums all efforts and materials required to acquire information and study Commercial Operating Experience. This subfunction includes the acquisition of operating data and information related to commercial operating experience, the development of appropriate data bases and the analysis of performance, reliability, and operating concerns.

## THE BDM CORPORATION

WBS Number: 1410-3  
WBS Phase: III  
WBS Title: Level II Coal  
Gasification Plant

This element sums all efforts and materials in systems engineering and analysis required to support the implementation of the Coal Gasification Plant. Level II analysis is considered to be at the plant and module levels and includes plant analysis and modeling, external requirements integration, module/system definition and control, interface definition and control, and safety assessments.

## THE BDM CORPORATION

WBS Number: 1420-3-  
WBS Phase: III  
WBS Title: Level III/Modules I, II,  
III, IV and Balance of  
Plant

This element sums all efforts and materials in systems engineering and analysis required to support the implementation of the individual plant modules. Level III analysis is considered to be at the module and systems levels and includes systems analysis and modeling, requirements evaluation and tradeoff, A/E design evaluation, material review evaluation, safety and quality evaluations, verification test assessment and other "make work" assessments.

## THE BDM CORPORATION

WBS Number: 1510-3-  
WBS Phase: III  
WBS Title: Administration and  
Control

This element sums all the efforts and materials required to Administer and Control efforts under the Development Support function. This subfunction includes the administration of all technology development activities and control of funds related to these activities.

## THE BDM CORPORATION

WBS Number: 1520-3-  
WBS Phase: III  
WBS Title: Task Performance

This element sums all efforts and materials required to evaluate task performance during plant implementation. This subfunction includes the development of a performance criteria for each major work element in the Coal Gasification Program, the continual monitoring of the status of the major work elements and evaluation of performance of the tasks.

## THE BDM CORPORATION

WBS Numbers: 1530-1-  
1530-2-  
1530-3-  
WBS Phases: I - III  
WBS Title: Assessment, Evaluation  
and Reporting

This element sums all efforts and materials required to perform a comprehensive critical technology assessment of the systems and technologies associated with the candidate processes under evaluation. This subfunction includes for each appropriate process the assessment of the system, subsystem and component performance, control, reliability and maintainability and identify potential problems and concerns relative to construction, operations, scale-up, environmental quality requirements, efficiency and cost. This subfunction also includes the development of specific recommendations for implementation.



## THE BDM CORPORATION

WBS Number: 1610-3-  
WBS Phase: III  
WBS Title: Construction Management

This element includes all efforts and materials required to ensure that a fully functioning plant is built, tested and started on schedule and within budget. Specific lower level activities which are included are:

- 1611-3- Construction Administration
- 1612-3- Construction Planning and Control
- 1613-3- Construction Quality Assurance
- 1614-3- Construction Safety Assurance

These items sum all efforts required for planning, organizing, directing, and coordinating, and controlling the construction of the Coal Gasification Plant.

## THE BDM CORPORATION

WBS Numbers: 1620-1-  
1620-2-  
1620-3-  
WBS Phases: I - III  
WBS Title: Engineering and Design

This element includes all efforts and materials required to perform Engineering and Design during the first three Phases of the program. During Phase I, this subfunction is directed at conceptual engineering and design. During Phase II this subfunction is directed at detailed engineering and design. And during Phase III, this subfunction is directed at final engineering efforts required to construct and install the systems. This subfunction includes the following activities during Phase III:

- 1621-3- A/E Engineering and Design
- 1622-3- TVA Engineering and Design
- 1623-3- Support Engineering and Design

# THE BDM CORPORATION

WBS Number: 1630-3-  
WBS Phase: III  
WBS Title: Major Equipment  
Procurement

This element includes all efforts and materials required to assure the procurement of all major equipment. This subfunction includes the following activities:

- 1631-3- Procurement Management
- 1632-3- Major Systems Procurement
- 1633-3- Vessels Procurement
- 1634-3- Mechanical Equipment Procurement
- 1635-3- Bulk Commodities Procurement
- 1636-3- Specialty Items Procurement

## THE BDM CORPORATION

WBS Number: 1640-3-  
WBS Phase: III  
WBS Title: Construction and  
Installation

This element includes all effort, materials, and equipment to manufacture components, assemble, integrate, prepare the site, construct and erect facilities, and connect utilities. This subfunction is divided into the following activities:

- 1641-3- Site Civil Development
- 1642-3- Major Equipment Erections
- 1643-3- Procured Subsystems Installation
- 1644-3- Procured Services

# THE BDM CORPORATION

WBS Number: 1650-3-  
WBS Phase: III  
WBS Title: Verification, Test and  
Startup

This element includes all effort, equipments and materials to accomplish test and checkout of the plant, modules, systems, etc. This will involve development of appropriate analytical models, test procedures, and laboratory support; development or acquisition of test equipment as needed; conduct of the tests; data management and reduction; and analysis of test results. This subfunction is divided into the following activities:

- 1651-3- Equipment Verification Tests
- 1652-3- System Verification Tests
- 1653-3- Module Test and Startup

## THE BDM CORPORATION

WBS Number: 1710-4-  
WBS Phase: IV  
WBS Title: Personnel Training

This element includes all efforts and materials necessary to perform the Personnel Training subfunction. This subfunction includes the training of plant supervisors, system operators, process engineers, maintenance and repair technicians and materials handlers.

## THE BDM CORPORATION

WBS Number: 1720-4-  
WBS Phase: IV  
WBS Title: Plant Operations

This element includes all efforts and materials required to ensure desire levels of production from each module.

## THE BDM CORPORATION

WBS Number: 1730-4-  
WBS Phase: IV  
WBS Title: Spares Procurement

This element involves the development of a spares plan, and purchasing, handling, storage and inventory control of the parts needed to keep the facility in operation.



## THE BDM CORPORATION

WBS Number: 1740-4-  
WBS Phase: IV  
WBS Title: Maintenance and Repair

The element involves the implementation of the preventive maintenance plan and the corrective maintenance identification procedures, use of the supporting information system and conduct of preventive maintenance and corrective repairs.

## THE BDM CORPORATION

WBS Number: 1750-4-  
WBS Phase: IV  
WBS Title: Plant Engineering

This element involves the effort and materials for design modifications and engineering to incorporate improved systems, subsystems, and components into the plant.

## THE BDM CORPORATION

WBS Number: 1760-4-

WBS Phase: IV

WBS Title: Materials Processing

This element involves the scheduling, procurement, delivery, processing and storage of raw materials needed for operation of the plant.

## THE BDM CORPORATION

WBS Number: 1611-3-  
WBS Phase: III  
WBS Title: Construction  
Administration

This element sums all efforts and materials required for the Construction Administration activity. This activity includes the following subactivities:

- Reviewing the various contractors' programs to accomplish the work, including the construction schedule, manpower and equipment usage.
- Coordinating the contractors' schedules with those of other contractors.
- Advising and assisting contractors in work methods.
- Assuring adherence to established construction schedules.
- Inspecting contractors' work to ensure good workmanship and adherence to sound construction practices.
- Coordinating the activities of the various contractors to avoid conflicts in scheduling, unnecessary peaking of manpower at the sites, and interferences between activities.
- Establishing minimum standards of housekeeping and assuring contractors' compliance.

## THE BDM CORPORATION

WBS Number: 1612-3-  
WBS Phase: III  
WBS Title: Construction Planning and  
Control

This element sums all efforts and materials required for Construction Planning and Control. Construction planning and control services include obtaining the data for preparing project schedules and budgets, periodic updating of schedules and budgets to reflect actual progress and costs, and implementing various schedule and cost engineering techniques to ensure the projects are completed on time and within budget. Specifically, planning and controls include:

- Obtaining information for preparing of all schedules.
- Coordinating with the construction contractors during the preparation and revision of all schedules.
- Preparing detail schedules in conjunction with the contractors as required.
- Monitoring progress of the entire project.
- Reporting to management any significant variations in actual performance from the schedule, then suggesting methods of corrective action.
- Preparing progress reports.
- Preparing a project code of accounts.
- Preparing periodic reports showing commitments to date and forecasts of final costs versus budget.
- Flagging any significant deviations from actual budgeted amounts, giving reasons.
- Preparing cost trends when a deviation from the budget is apparent.
- Preparing and analyzing unit costs reports.
- Preparing special cost studies of operations as required.
- Checking estimates accompanying the contractor's claim for adjustment.

## THE BDM CORPORATION

WBS Number: 1613-3-  
WBS Phase: III  
WBS Title: Construction Quality  
Assurance

This element sums all efforts and materials required to assure reliability and maintainability of the plant construction effort. This activity includes the implementation of reliability and quality procedures developed under work element (1130-2-).

# THE BDM CORPORATION

WBS Number: 1614-3-  
WBS Phase: III  
WBS Title: Construction Safety  
Assurance

This element sums all efforts and materials required to assure safety during plant implementation. This activity includes review of all construction plans and procedures to safeguard against accidents during construction, development and implementation of construction safety assurance measures, and review of operational methods to avoid operational safety problems created during construction and installation.

## THE BDM CORPORATION

WBS Number: 1621-3-  
WBS Phase: III  
WBS Title: A/E Engineering and  
Design

This element sums all efforts and materials required by the A/E Contractors to perform engineering and design during Phase III. This activity includes efforts directed at project engineering, process engineering, mechanical engineering, design specialties, instrumentation and control and other engineering disciplines.



## THE BDM CORPORATION

WBS Number: 1622-3-  
WBS Phase: III  
WBS Title: TVA Engineering and  
Design

This element sums all efforts and materials required by the Tennessee Valley Authority personnel to perform engineering and design during Phase III. This activity includes efforts directed at project engineering, process engineering, mechanical engineering, design specialties, instrumentation and control and other engineering disciplines.

## THE BDM CORPORATION

WBS Number: 1623-3-  
WBS Phase: III  
WBS Title: Support Engineering and  
Design

This element sums all efforts and materials required by other support organizations to perform engineering and design during Phase III. This activity includes efforts directed at project engineering, process engineer, mechanical engineering, design specialties, instrumentation and control and other engineering disciplines.

# THE BDM CORPORATION

WBS Number: 1631-3-  
WBS Phase: III  
WBS Title: Procurement Management

This element sums all efforts and materials required to perform Procurement Management. This activity includes the development of a procurement plan, procurement schedule monitoring and coordination of purchasing, handling, storage and inventory control of the equipment needed during the construction and installation of the plant.

## THE BDM CORPORATION

WBS Number: 1632-3-  
WBS Phase: III  
WBS Title: Major Systems Procurement

This element sums all efforts and materials required to procure major systems. This activity includes purchasing, handling, storage and inventory control of systems such as gasifiers, air separators plant, incinerators, etc.

## THE BDM CORPORATION

WBS Number: 1633-3-  
WBS Phase: III  
WBS Title: Vessels Procurement

This element sums all efforts and materials required to procure vessels not already accounted for under Major Systems Procurement (1632-3-). This activity includes purchasing, handling, storage and inventory control of vessels such as storage tanks, spare vessels in major systems, and vessels requiring long lead times to procure.

# THE BDM CORPORATION

WBS Number: 1634-3-  
WBS Phase: III  
WBS Title: Mechanical Equipment  
Procurement

This element sums all efforts and materials required to procure mechanical equipment not already accounted for under Major Systems Procurement (1632-3-). This activity includes purchasing, handling, storage and inventory control of mechanical equipment such as cranes, conveyors, spare pumps and other mechanical equipment in major systems.

## THE BDM CORPORATION

WBS Number: 1635-3-  
WBS Phase: III  
WBS Title: Bulk Commodities  
Procurement

This element sums all efforts and materials required to procure bulk commodities. This activity includes purchasing, handling, storage and inventory control of bulk materials such as the initial charge of coal and catalysts and chemicals, concrete, paving materials, lumber, electric supplies and other bulk commodities.

## THE BDM CORPORATION

WBS Number: 1636-3-  
WBS Phase: III  
WBS Title: Specialty Items  
Procurement

This element sums all efforts and materials required to procure specialty items. This activity includes purchasing, handling, storage and inventory control of specialty items such as gasifier equipment, environmental protection equipment, computers and computer software, instrumentation and control devices and other specialty items requiring unique tooling or extraordinary manufacturing processes requiring benchmarks or other special coordination during procurement.



## THE BDM CORPORATION

WBS Number: 1641-3-

WBS Phase: III

WBS Title: Site Civil Development

This element sums all efforts and materials required for Site Civil Development. This activity includes site preparation, foundation excavation, sewer development, road and right-of-ways construction and other construction activities not assignable to the erection or installation of major systems.

## THE BDM CORPORATION

WBS Number: 1642-3-

WBS Phase: III

WBS Title: Major Equipment Erections

This element sums all efforts and materials required for Major Equipment Erections. This activity includes the construction of facilities and erections such as water cooling towers, walkways, and crane structures.

# THE BDM CORPORATION

WBS Number: 1643-3-  
WBS Phase: III  
WBS Title: Procured Subsystems  
Installation

This element sums all efforts and materials required for installation of procured subsystems. This activity includes the assembly and installation of plant equipment and connection to the required utilities and other support facilities.

C-2

H-III-67

## THE BDM CORPORATION

WBS Number: 1644-3-  
WBS Phase: III  
WBS Title: Procured Services

This element sums all efforts and materials expended on Procured Services. This activity includes procured services not already accounted for under other work elements such as legal fees, accounting costs and consulting contracts.

# THE BDM CORPORATION

WBS Number: 1651-3-  
WBS Phase: III  
WBS Title: Equipment Verification  
Tests

This element sums all efforts and materials required to perform Equipment Verification Tests. This activity includes all efforts to test individual equipment as it is manufactured in the plant or installed and connected to the system. This activity includes the conduct of the test; data collection, validation and management; analysis; and evaluation.

## THE BDM CORPORATION

WBS Number: 1652-3-  
WBS Phase: III  
WBS Title: System Verification Tests

This element sums all efforts and materials required to perform System Verification Tests. This activity includes all efforts to test and evaluate each system after they are constructed and installed. Tasks include development of a system test plan; conduct of the system test; data collection, validation and management; analysis; and evaluation.

## THE BDM CORPORATION

WBS Number: 1653-3-  
WBS Phase: III  
WBS Title: Module Test and Startup

This element sums all efforts and materials required to perform Module Test and Startup. This activity includes all efforts to test and evaluate each module as it is brought into operation. This activity does not commence for a module until System Verification Tests (1652-3-) are complete. Tasks include development of a module test plan; conduct of the module test; data collection, validation and managment; analysis; evaluation; and actual startup of module operation.

**THE BDM CORPORATION**

**CHAPTER III**  
**B. HARDWARE ELEMENTS**  
**DIMENSION AND DICTIONARY**



B. HARDWARE ELEMENTS DIMENSION AND DICTIONARY

The hardware elements dimension contains all of the presently defined hardware elements of the Coal Gasification Plant broken out into plant, module, and system levels. Inherent within this dimension is the capability for further expansion to lower levels such as subsystem, assemblies, subassemblies, components, etc.. Limited only by the realism of the requirements. A typical hardware element WBS is shown in Figure III-2. Definitions of the individual elements are contained in the following pages.

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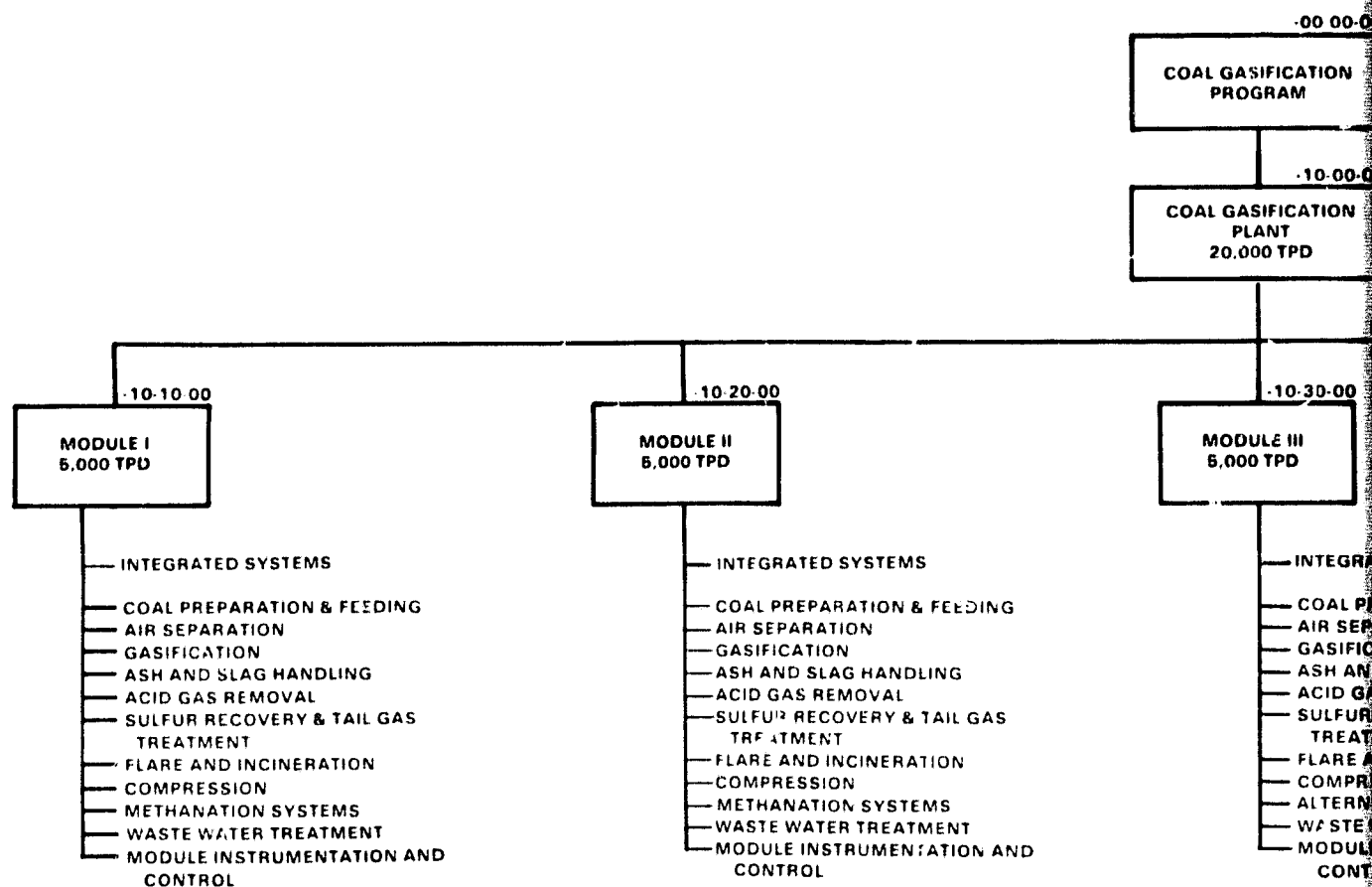
# THE BDM CORPORATION

## LEVELS I PROGRAM

## II PLANT

## III MODULE

## IV SYSTEM



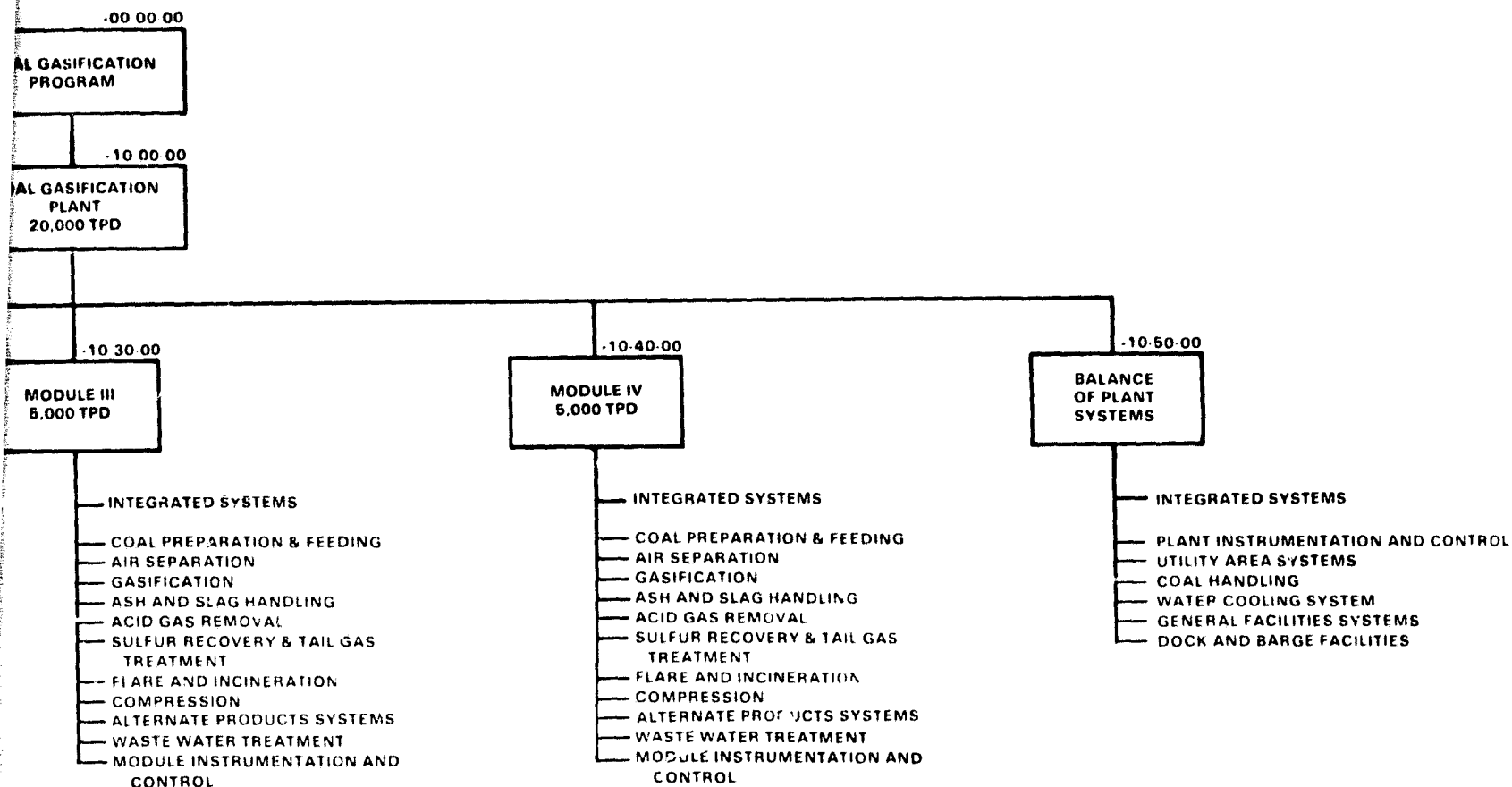
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Figure III-2. Coal Gasification Program



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HARDWARE ELEMENTS DICTIONARY

CONTENTS

<u>WBS NUMBER(S)</u>	<u>WBS TITLE</u>
<u>PROGRAM AND PLANT LEVELS</u>	
-00-00-00	Coal Gasification Program
-10-00-00	Coal Gasification Plant
-11-00-00	Plant Integrated Systems
<u>MODULE LEVEL</u>	
-10-10-00	Module I
-10-20-00	Module II
-10-30-00	Module III
-10-40-00	Module IV
-10-11-00	Integrated Systems
-10-21-00	
-10-31-00	
-10-41-00	
-10-50-00	Balance of Plant
-10-51-00	Integrated Systems

# THE BDM CORPORATION

## HARDWARE ELEMENTS DICTIONARY

### CONTENTS (Continued)

#### WBS NUMBER

#### WBS TITLE

#### SYSTEM LEVEL

-10-10-01	Coal Preparation & Feeding
-10-20-01	
-10-30-01	
-10-40-01	
-10-10-02	Air Separation
-10-20-02	
-10-30-02	
-10-40-02	
-10-10-03	Gasification
-10-20-03	
-10-30-03	
-10-40-03	
-10-10-04	Ash and Slag Handling
-10-20-04	
-10-30-04	
-10-40-04	
-10-10-05	Acid Gas Removal
-10-20-05	
-10-30-05	
-10-40-05	

HARDWARE ELEMENTS DICTIONARY

CONTENTS (Continued)

<u>WBS NUMBERS(S)</u>	<u>WBS TITLE</u>
-10-10-06	Sulfur Recovery & Tailgas Treatment
-10-20-06	
-10-30-06	
-10-40-06	
-10-10-07	Flare and Incineration
-10-20-07	
-10-30-07	
-10-40-07	
-10-10-08	Compression
-10-20-08	
-10-30-08	
-10-40-08	
-10-10-09	Methanation Systems
-10-20-09	
-10-30-09	Alternate Products Systems
-10-40-09	
-10-10-10	Waste Water Treatment
-10-20-10	
-10-30-10	
-10-40-10	

# THE BDM CORPORATION

## HARDWARE ELEMENTS DICTIONARY

### CONTENTS (Continued)

<u>WBS NUMBERS(S)</u>	<u>WBS TITLE</u>
-10-10-11	Module Instrumentation and Control
-10-20-11	
-10-30-11	
-10-40-11	
-10-50-11	Plant Instrumentation and Control
-10-50-12	Utility Area Systems
-10-50-13	Coal Handling
-10-50-14	Water Cooling System
-10-50-15	General Facilities Systems
-10-50-16	Dock and Barge Facilities

## THE BDM CORPORATION

WBS Number: -00-00-00

WBS Title: Coal Gasification Program

This element is the top level element which identifies all efforts and materials required for defining, implementing and controlling the 20,000 ton per day Coal Gasification Plant. This item includes those projects which are necessary to provide a total program. This element need not be included in the hardware elements dimension since all elements within the dimension may be aggregated to the plant. This WBS element is included in the dictionary to provide a link between the hardware elements dimension and the phases and functions dimension.



## THE BDM CORPORATION

WBS Number: -10-00-00

WBS Title: Coal Gasification Plant

This hardware element is a summary level element composed of all efforts and materials required for the design, development, construction, testing and operation of the 20,000 ton per day Coal Gasification Plant. This item includes those modules and systems which are combined to provide a total plant:

-11-00-00	Plant Integrated Systems
-10-10-00	Module I
-10-20-00	Module II
-10-30-00	Module III
-10-40-00	Module IV
-10-50-00	Balance of Plant Systems

## THE BDM CORPORATION

WBS Number: -11-00-00

WBS Title: Plant Integrated Systems

This hardware element contains the hardware related efforts and materials required for the design, development, construction, testing and operation of the total Coal Gasification Plant which cannot be allocated to individual hardware elements below the plant level. It includes elements associated with the integration, test, system engineering, and management of the total Coal Gasification Plant.

# THE BDM CORPORATION

WBS Number: -10-10-00

WBS Title: Module I

This hardware element sums all the efforts and materials required for the design, development, construction, and test of the first 5,000 ton per day module. This element includes all module specific systems:

- 10-11-00 Integrated Systems
- 10-10-01 Coal Preparation & Feeding
- 10-10-02 Air Separation
- 10-10-03 Gasification
- 10-10-04 Ash and Slag Handling
- 10-10-05 Acid Gas Removal
- 10-10-06 Sulfur Recovery and Tailgas Treatment
- 10-10-07 Flare and Incineration
- 10-10-08 Compression
- 10-10-09 Methanation Systems
- 10-10-10 Waste Water Treatment
- 10-10-11 Module Instrumentation and Control

# THE BDM CORPORATION

WBS Number: -10-20-00  
WBS Title: Module II

This hardware element sums all the efforts and materials required for the design, development, construction, and test of the second 5,000 ton per day module. This element includes all module specific systems:

- 10-21-00 Integrated Systems
- 10-20-01 Coal Preparation & Feeding
- 10-20-02 Air Separation
- 10-20-03 Gasification
- 10-20-04 Ash and Slag Handling
- 10-20-05 Acid Gas Removal
- 10-20-06 Sulfur Recovery and Tailgas Treatment
- 10-20-07 Flare and Incineration
- 10-20-08 Compression
- 10-20-09 Methanation Systems
- 10-20-10 Waste Water Treatment
- 10-20-11 Module Instrumentation and Control

# THE BDM CORPORATION

WBS Number: -10-30-00  
WBS Title: Module III

This hardware element sums all the efforts and materials required for the design, development, construction, and test of the third 5,000 ton per day module. This element includes all module specific systems:

- 10-31-00 Integrated Systems
- 10-30-01 Coal Preparation & Feeding
- 10-30-02 Air Separation
- 10-30-03 Gasification .
- 10-30-04 Ash and Slag Handling
- 10-30-05 Acid Gas Removal
- 10-30-06 Sulfur Recovery and Tailgas Treatment
- 10-30-07 Flare and Incineration
- 10-30-08 Compression
- 10-30-09 Alternate Product Systems
- 10-30-10 Waste Water Treatment
- 10-30-11 Module Instrumentation and Control

# **THE BDM CORPORATION**

**WBS Number: -10-40-00**

**WBS Title: Module IV**

**This hardware element sums all the efforts and materials required for the design, development, construction, and test of the fourth 5,000 ton per day module. This element includes all module specific systems:**

<b>-10-41-00</b>	<b>Integrated Systems</b>
<b>-10-40-01</b>	<b>Coal Preparation &amp; Feeding</b>
<b>-10-40-02</b>	<b>Air Separation</b>
<b>-10-40-03</b>	<b>Gasification</b>
<b>-10-40-04</b>	<b>Ash and Slag Handling</b>
<b>-10-40-05</b>	<b>Acid Gas Removal</b>
<b>-10-40-06</b>	<b>Sulfur Recovery and Tailgas Treatment</b>
<b>-10-40-07</b>	<b>Flare and Incineration</b>
<b>-10-40-08</b>	<b>Compression</b>
<b>-10-40-09</b>	<b>Alternate Products Systems</b>
<b>-10-40-10</b>	<b>Waste Water Treatment</b>
<b>-10-40-11</b>	<b>Module Instrumentation and Control</b>

## THE BDM CORPORATION

WBS Number:   -10-11-00  
                  -10-21-00  
                  -10-31-00  
                  -10-41-00

WBS Title:     Integrated Systems

This hardware element contains the hardware related efforts and materials required for the design, development, construction and test of the total module which cannot be allocated to individual hardware elements below the module level. It includes elements associated with the integration, test, engineering, and program management of the total module.

# **THE BDM CORPORATION**

**WBS Number: -10-50-00**

**WBS Title: Balance of Plant Systems**

This hardware element sums all efforts and materials required for the design, development, construction and test of the Balance of Plant Systems. The balance of plant systems consist of nonmodule specific process systems and general facilities outside the process battery limits. This element is subdivided into the following:

- 10-51-00 Integrated Systems**
- 10-50-11 Plant Instrumentation and Control**
- 10-50-12 Utility Area Systems**
- 10-50-13 Coal Handling**
- 10-50-14 Water Cooling System**
- 10-50-15 General Facilities Systems**
- 10-50-16 Dock and Barge Facilities**



## THE BDM CORPORATION

WBS Number: -10-51-00

WBS Title: Integrated Systems

This hardware element contains the hardware related efforts and materials required for the design, development, construction and test of the Balance of Plant Systems which cannot be allocated to individual modules. It includes elements associated with the integration, test, system engineering and program management of the total balance of plant.

## **THE BDM CORPORATION**

**WBS Numbers:**    -10-10-01  
                     -10-20-01  
                     -10-30-01  
                     -10-40-01

**WBS Title:**        Coal Preparation &  
                         Feeding

This hardware element sums all efforts and materials required for the design, development, construction and test of the Coal Preparation and Feeding System. This element includes the coal feeders, pumps, hoppers, conveyors, crushers, driers, and sampling subsystems used to crush, wash (if required), and prepare the feed coal for the process units.

## THE BDM CORPORATION

WBS Numbers: -10-10-02

-10-20-02

-10-30-02

-10-40-02

WBS Title: Air Separation

This hardware element sums all efforts and materials required for the design, development, construction and test of the Air Separation System. This element includes compressor, shop fabricated pressure vessel, air separation and valve/nozzle subsystems necessary to separate the air components and supply pure oxygen to the coal gasifier. The Air Separation system also includes the following subsystems:

- Fractionation
- Oxygen Compression
- Oxygen Holders
- Nitrogen Storage (liquid and gas)
- Stream to out-of-plant argon

## THE BDM CORPORATION

WBS Numbers: -10-10-03

-10-20-03

-10-30-03

-10-40-03

WBS Title: Gasification

This hardware element sums all efforts and materials required for the design, development, construction and test of the Coal Gasification System. This element includes the reactor vessel, refractory lining, nozzles/orifices, mixing chamber, heat exchanger and waste heat recovery subsystems used to generate the medium-BTU fuel gas. This system also includes all equipment required to perform initial gas clean-up and cooling and the following subsystems:

- Gasifiers
- Waste Heat Boiler
- Gas Cooling
- Dust Removal
- Slag Removal
- Disintegration
- Blowers

## THE BDM CORPORATION

WBS Numbers: -10-10-04

-10-20-04

-10-30-04

-10-40-04

WBS Title: Ash and Slag Handling

This hardware element sums all efforts and materials required for the design, development, construction and test of the Ash and Slag Handling System. This element includes the slag handling and transfer, slag removal, filtration and basin separation subsystems necessary to separate and treat the ash and ash/slag solids prior to disposal. The Ash and Slag Handling System also includes the following subsystems:

- Gravity Settler
- Filter Presses
- Conveyors to Solid Waste Storage

## THE BDM CORPORATION

WBS Numbers: -10-10-05

-10-20-05

-10-30-05

-10-40-05

WBS Title: Acid Gas Removal

This hardware element sums all efforts and materials required for the design, development, construction and test of the Acid Gas Removal System. This element includes the extraction subsystems necessary for the removal of  $H_2S$ ,  $CO_2$  and organic sulfur components from the fuel gas. The Acid Gas Removal System also includes the following subsystems:

- Electrostatic Precipitators
- Initial Compression
- Catalytic Converters
- Hydrolysis
- Gas Scrubbing

## THE BDM CORPORATION

WBS Numbers:   -10-10-06  
                  -10-20-06  
                  -10-30-06  
                  -10-40-06

WBS Title:       Sulfur Recovery and  
                  Tailgas Treatment

This hardware element sums all efforts and materials required for the design, development, construction and test of the Sulfur Recovery and Tailgas Treatment System. The element includes the absorber, converter, pump and condenser subsystems required to recover and process the sulfur component prior to onsite storage. The Sulfur Recovery and Tailgas Treatment System also includes the following subsystems:

- Claus Process
- Tailgas Treatment
- Prilling Process

## THE BDM CORPORATION

WBS Numbers: -10-10-07

-10-20-07

-10-30-07

-10-40-07

WBS Title: Flare and Incineration

This hardware element sums all efforts and materials required for the design, development, construction and test of the Flare and Incineration System. This element includes the process heater, heat exchanger and other fixed equipment subsystems necessary to incinerate the tail gases and off-gases prior to release into the atmosphere. The Flare and Incineration System also includes the following subsystems:

- Emergency Disposal
- Combustible Waste Subsystem



## THE BDM CORPORATION

WBS Numbers: -10-10-08

-10-20-08

-10-30-08

-10-40-08

WBS Title: Compression

This hardware element sums all efforts and materials required for the design, development, construction and test of the Compression System. This element includes multi-stage compressors, shop fabricated pressure vessels, gas coolers, heat exchanger subsystems used to condense the process effluents and separate them from the fuel gas components.

## THE BDM CORPORATION

WBS Number: -10-10-09

-10-20-09

WBS Title: Methanation Systems

This hardware element sums all efforts and materials required for the design, development, construction and test of the Methanation Systems. This element includes the systems necessary to produce methane, such as:

- Integrated Systems
- Shift Conversion
- Methanation
- Gas Drying

# THE BDM CORPORATION

WBS Number: -10-30-09

-10-40-09

WBS Title: Alternate Products  
Systems

This hardware element sums all efforts and materials required for the design, development, construction and test of the Alternate Products Systems. This element includes the systems necessary to produce methanol, methane, hydrogen and gasoline such as:

- Integrated Systems
- Shift Conversion
- Methanation
- Gas Drying
- Methanol Synthesis
- Gasoline Synthesis
- Hydrogen Recovery

## THE BDM CORPORATION

WBS Numbers: -10-10-10

-10-20-10

-10-30-10

-10-40-10

WBS Title: Waste Water Treatment

This hardware element sums all efforts and materials required for the design, development, construction and test of the Waste Water Treatment System. This element (if required) includes the Tar/Oil Separation, Phenol Recovery,  $\text{NH}_3$  Recovery, Biological Treatment and Sour Water Stripper subsystems used to separate, process and recover the tar/oil, phenol and ammonia effluents prior to on-site storage. The Waste Water Treatment System also includes the following subsystems:

- Cooling Tower Blow Down
- Water Treatment Blow Down
- Steam Generation Blow Downs
- Sanitary Treatment Effluents
- Coal Pile Run-Off
- Solid Storage Run-Off
- Waste Handling

## THE BDM CORPORATION

WBS Number: -10-10-11

-10-20-11

-10-30-11

-10-40-11

WBS Title: Module Instrumentation  
and Control

This hardware element sums all efforts and materials required for the design, development, construction and test of the Module Instrumentation and Control System. This element includes sensors, instrument panels, process controls, control room and computer subsystems necessary to monitor and control the individual modules.

## THE BDM CORPORATION

WBS Number: -10-50-11

WBS Title: Plant Instrumentation and  
Control

This hardware element sums all efforts and materials required for the design, development, construction and test of the Plant Instrumentation and Control System. This element includes sensors, instrument panels, process controls, control room and computer subsystems necessary to establish a plant level monitoring and control function. The hardware elements assigned to the Plant Instrumentation and Control System are not module specific systems.

# THE BDM CORPORATION

WBS Number: -10-50-12

WBS Title: Utility Area Systems

This hardware element sums all efforts and materials required for the design, development, construction and test of the systems assigned to the Utility Area. This element includes some of the following utility support systems:

- Steam Generation and Distribution
- Boiler Feedwater
- Raw-Water Make-Up (potable water)
- Raw-Water Treatment and Storage
- Instrument Air & Inert Gases
- Start-Up Boilers
- Superheaters

# THE BDM CORPORATION

WBS Number: -10-50-13

WBS Title: Coal Handling

This hardware element sums all efforts and materials required for the design, development, construction and test of the Coal Handling System. This element includes the coal yard garage, sample houses, breakers, transfer sections, control building, live coal storage building, and all storage, reclaiming, transfer conveyor subsystems with the appropriate dust control subsystems. This element also includes all truck and barge receiving unloading, docking and water front work not accounted for under the dock and barge facilities accounting center (-10-50-16).



# THE BDM CORPORATION

WBS Numbers: -10-50-14

WBS Title: Water Cooling System

This hardware element sums all efforts and materials required for the design, development, construction and test of the Water Cooling System. This element includes the pumping, heat exchanger, cooling towers, spray ponds and chiller subsystems necessary to supply cooling water to the process plant.

# THE BDM CORPORATION

WBS Number: -10-50-15  
WBS Title: General Facilities  
Systems

This hardware element sums all effort and materials required for the design, development, and construction of the General Facilities Systems. This element is sub-divided into the following:

- Land Acquisition
- Site Preparation
- Buildings & Support Facilities
- Solids Waste Disposal
- By Products and Chemical Storage
- Plant Power, Lighting and Communications
- Roads - On Site
  - Primary and Secondary
  - Temporary and Permanent
- Fencing, Security Layout and Guardhouse(s)
- Storm Sewer Systems
- Sewer Plant
- Fire Protection System
- Interconnecting Piping
- Railroad Service within the Plant Boundary

**WBS Number: -10-50-16**

**WBS Title: Dock and Barge Facilities**

This hardware element sums all efforts and materials required for the design, development, construction and test of the Dock and Barge Facilities. This element includes a dock provided with elevator type unloader(s); a barge pulling and positioning subsystem; a barge cleanout subsystem; and sufficient mooring facilities to accomodate twenty-four loaded and twenty-four empty jumbo barges. This element also includes barge unloading control subsystems, crew building(s), transfer stations at the barge site and a surge hopper subsystem.

**COLUMNS**

XXXX-X

**ROWS**

-XX -XX -XX

PHASE

PROGRAM

FUNCTION

SUBFUNCTION

ACTIVITY

PLANT

SYSTEM MODULE

FORLORD J. KAYE

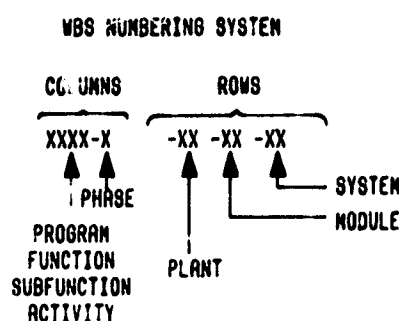
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LABOR HOURS  
PROGRAM MANAGEMENT  
PRODUCT MARKETING/DISTRIBUTION  
ENVIRONMENTAL PROTECTION  
SYSTEMS ENGINEERING & ANALYSIS  
DEVELOPMENT SUPPORT  
PLANT IMPLEMENTATION  
OPERATIONS AND MAINTENANCE



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### IV & BALANCE OF PLANT SYSTEMS

[illegible]



2 BOLDOUT FRAME

BOOK QUALITY

PROGRAM		COAL GASIFICATION PROGRAM 1000-0-																			
PHASE		PHASE III 1000-3- PLANT CONSTRUCTION																			
FUNCTION		PLANT IMPLEMENTATION 1000-3-																			
FUNCTION		CONSTRUCTION MANAGEMENT				ENGINEERING AND DESIGN				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP			
		1010-3-				1020-3-				1030-3-				1040-3-				1050-3-			
FUNCTION		DESIGN SUBTOTAL				MAJOR EQUIPMENT PROCUREMENT SUBTOTAL				CONSTRUCTION AND INSTALLATION SUBTOTAL				VERIFICATION TEST AND START-UP SUBTOTAL							
FUNCTION		DESIGN AND DESIGN				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		SUPPORT ENGINEERING AND DESIGN				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP				VERIFICATION TEST AND START-UP							
FUNCTION		VESSELS PROCUREMENT				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		MECHANICAL EQUIPMENT PROCUREMENT				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		BULK COMMODITIES PROCUREMENT				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		SPECIALTY ITEMS PROCUREMENT				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		CONSTRUCTION AND INSTALLATION				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		SITE CIVIL DEVELOPMENT				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		MAJOR EQUIPMENT PROCUREMENT				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		PROCURED SUBSYSTEMS INSTALLATION				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		VERIFICATION TEST AND START-UP				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		EQUIPMENT VERIFICATION TESTS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		SYSTEM VERIFICATION TESTS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		MODULE TEST AND START-UP				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		LABOR DOLLARS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		FRINGE BENEFITS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		EQUIPMENT AND HARDWARE				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		MATERIALS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		SUBCONTRACTS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		EQUIPMENT, HARDWARE, MATERIAL, AND SUBCONTRACT BURDEN				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		OTHER DIRECT COSTS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		OVERHEAD				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		GENERAL AND ADMINISTRATIVE				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							
FUNCTION		OTHER INDIRECT COSTS				MAJOR EQUIPMENT PROCUREMENT				CONSTRUCTION AND INSTALLATION				VERIFICATION TEST AND START-UP							

WBS COLUMN NUMBER

1000-3-

1001-3-

1002-3-

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LABOR HOURS

PROGRAM MANAGEMENT

PRODUCT MARKETING/DISTRIBUTION

ENVIRONMENTAL PROTECTION

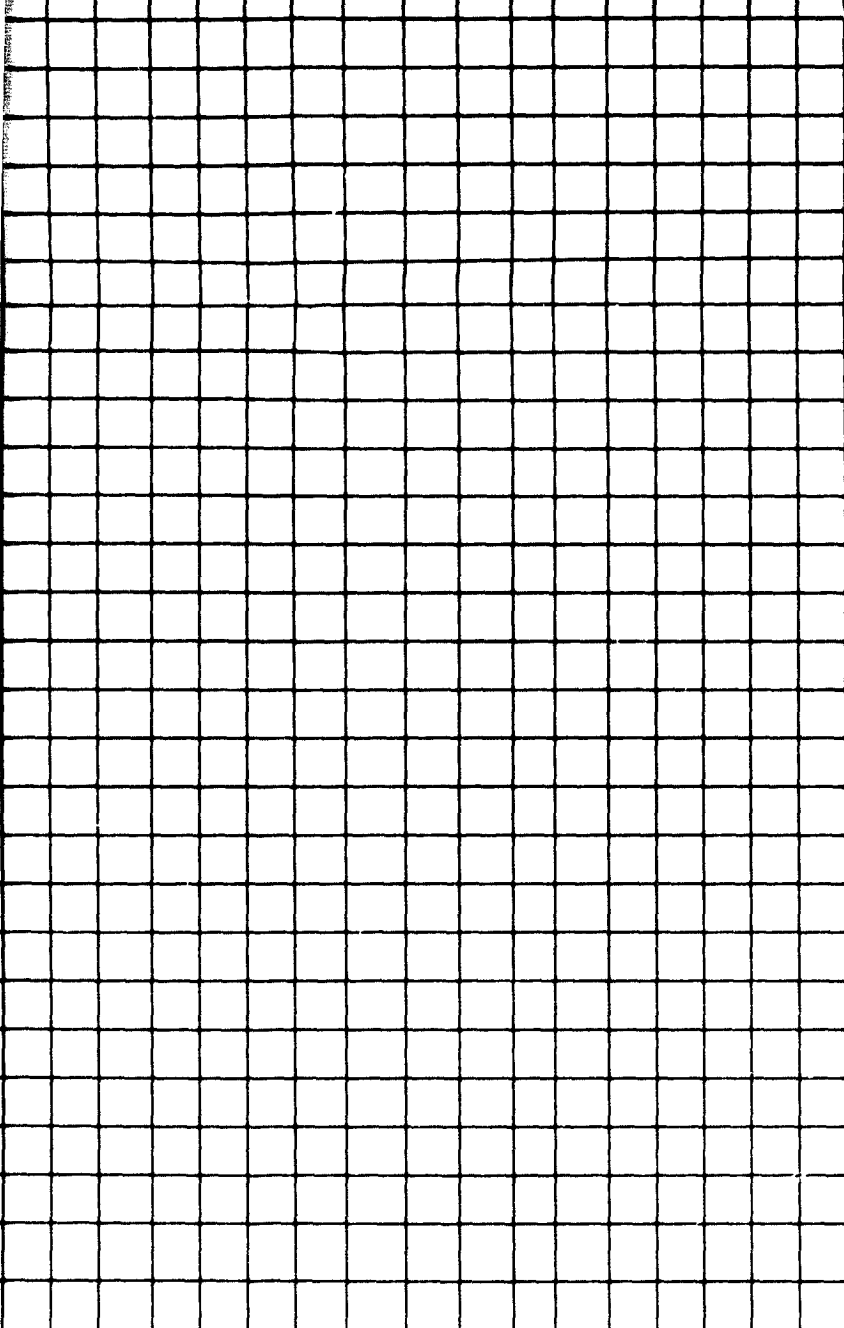
SYSTEMS ENGINEERING & ANALYSIS

DEVELOPMENT SUPPORT

PLANT IMPLEMENTATION

OPERATIONS AND MAINTENANCE



	LABOR HOURS
	PROGRAM MANAGEMENT
	PRODUCT MARKETING/DI
	ENVIRONMENTAL PROTEC
	SYSTEMS ENGINEERING
	DEVELOPMENT SUPPORT
	PLANT IMPLEMENTATION
	OPERATIONS AND MAINT